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Cost-effectiveness analysis on screening for colorectal neoplasm and management of colorectal cancer in Asia

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SUMMARY

Background
Faecal occult blood testing (FOBT), flexible sigmoidoscopy (FS) and colonoscopy are recommended for subjects above 50 years of age for screening for colorectal cancer (CRC).

Aim
To evaluate the cost-effectiveness of FOBT, FS and colonoscopy on the basis of disease prevalence, compliance rate and cost of screening procedures in Asian countries.

Methods
A hypothetical population of 100 000 persons aged 50 undergoes either FOBT annually, FS every 5 years or colonoscopy every 10 years until the age of 80 years. Patients with positive FOBT or polyp in FS are offered colonoscopy. Surveillance colonoscopy is repeated every 3 years. The treatment cost of CRC, including surgery and chemotherapy, was evaluated. A Markov model was used to compare the cost-effectiveness of different screening strategies.

Results
Assuming a compliance rate of 90%, colonoscopy, FS and FOBT can reduce CRC incidence by 54.1%, 37.1% and 29.3% respectively. The incremental cost-effectiveness ratio (ICER) for FOBT (US$6222 per life-year saved) is lower than FS (US$8044 per life-year saved) and colonoscopy (US$7211 per life-year saved). When the compliance rate drops to 50% and 30%, FOBT still has the lowest ICER.

Conclusion
FOBT is cost-effective compared to FS or colonoscopy for CRC screening in average-risk individuals aged from 50 to 80 years.

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INTRODUCTION

With the decline in the incidence of gastric, oesophageal and hepatocellular carcinoma, colorectal cancer (CRC) has become one of the most common malignancies in Asia. In high-incidence countries such as Japan, Korea, Singapore and Hong Kong, the incidence of CRC is comparable to that of Western countries.[1] The incidence of advanced colorectal neoplasm is also found to be comparable to that of Western countries based on reports from China, Korea and Taiwan.[2–4] Two Asian multicentre colonoscopy surveys in symptomatic and asymptomatic subjects reported incidence rates of advanced colorectal neoplasm as 7.8%[5] and 4.5%, respectively.[6] These figures are comparable to the larger Western series using colonoscopy as a screening tool for colorectal neoplasm.[7–10] In view of the rising incidence of the disease, the Asia Pacific Working Group on Colorectal Cancer has recently drawn a consensus guideline on CRC screening suggesting faecal occult blood test (FOBT), flexible sigmoidoscopy (FS) and colonoscopy as the recommendable options.[11] Yet, most Asian countries have not adopted a national strategy for CRC screening and tests are only performed in a spontaneous or opportunistic manner. One of the reasons for hesitancy in drafting national policy by health authorities is the financial burden incurred on the healthcare system.

There are few cost-effectiveness analyses performed on CRC screening. Sonnenberg *et al.*[12] compared three screening strategies in the US and found that colonoscopy represents a cost-effective means of screening, especially when the compliance rate is low. McGrath *et al.*[13] tested four screening methods [FOBT, FS, double-contrast barium enema (DCBE) and colonoscopy] and concluded that colonoscopy is the most cost-effective method of finding advanced colonic neoplasm, whereas Frazier *et al.*[14] compared different screening strategies and showed that unrehydrated FOBT followed by sigmoidoscopy is more cost-effective than colonoscopy. On the other hand, McMahon *et al.*[15] reported that DCBE is the most cost-effective method in CRC screening. However, all these studies are based on assumptions of compliance and cost of procedures in North America. The healthcare structure and health-seeking behaviour in Asia are different. On the other hand, none of these analyses has taken into account the cost of subsequent treatment of CRC according to the staging of CRC. With advancement of new chemotherapeutic agents, the cost of treatment and the expected life expectancy have changed substantially in the last decade.

This study applies the Markov model to evaluate the cost-effectiveness of FOBT, FS and colonoscopy on the basis of disease prevalence, compliance rate and cost of screening procedures in Asia. As DCBE and CT colonography have not been recommended by the Asia Pacific Working Group Consensus Guidelines,[11] they are not included in this analysis.

METHODS

Decision model framework

A hypothetical population of 100 000 people aged 50 years with no medical history or clinical symptoms of CRC entered a decision analysis model based on the Markov process (Figures 1–3). The whole population underwent three different screening strategies – FOBT, FS and colonoscopy – and was followed up until the age of 80 years. These strategies were compared against no screening.

Strategy 1: FOBT as primary screening procedure. Under this strategy, every eligible subject is offered guaiac-based FOBT on three consecutive samples. Those with negative FOBT are to repeat the test annually. With positive FOBT, subjects are invited to colonoscopy. Polyps found are removed and surveillance colonoscopy will be arranged every 3 years until no more polyps are found. In the case of normal findings on colonoscopy, FOBT is resumed after 10 years.

Strategy 2: FS as primary screening procedure. Under this strategy, every eligible subject is offered FS. When no polyp is found, FS is repeated after 5 years. Subjects with polyps found are offered colonoscopy. Polyps found are removed and surveillance colonoscopy will be arranged every 3 years until no more polyps are found. In the case of normal findings on colonoscopy, FS is resumed after 10 years.

Strategy 3: Colonoscopy as primary screening procedure. Under this strategy, every eligible subject is offered direct colonoscopy. If there are no abnormal findings, colonoscopy is repeated after 10 years. Polyps found during colonoscopy are removed and

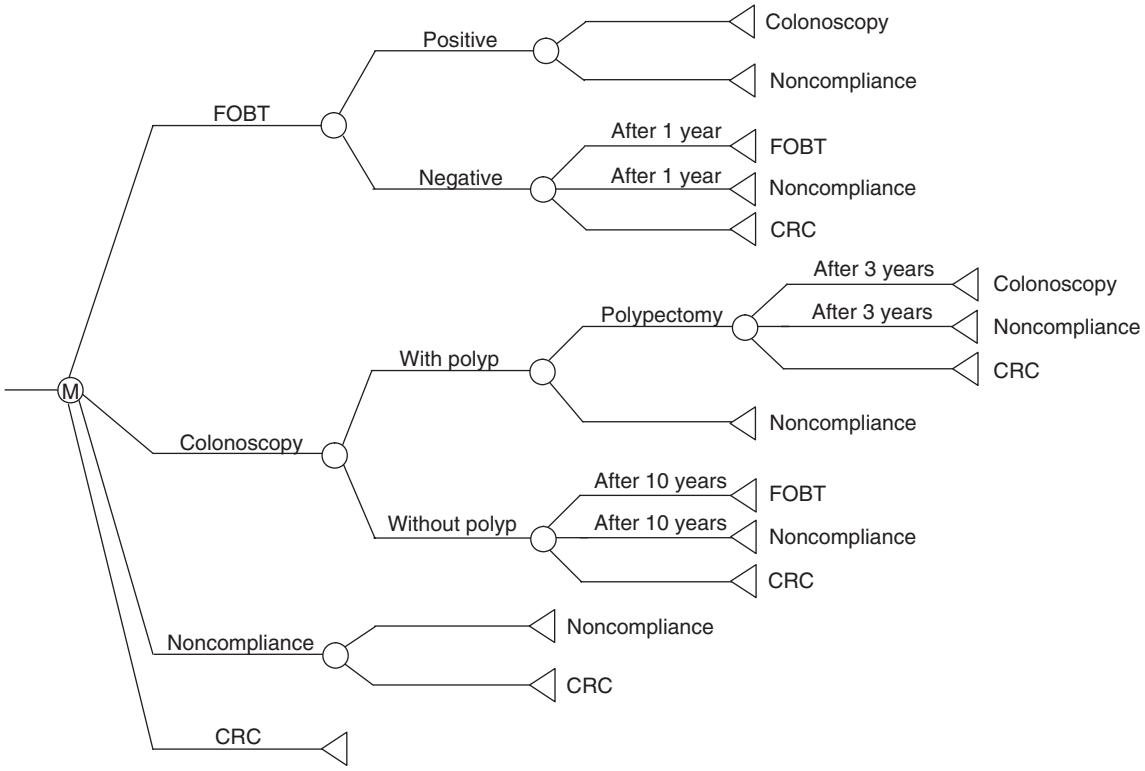

Figure 1. Markov process on strategy 1 using faecal occult blood test as primary screening procedure. Transitions of patients to different stages are described. Annual mortality was also counted in the model. Patients were followed up from years 50 to 80. FOBT, faecal occult blood test; CRC, colorectal cancer.

surveillance colonoscopy is arranged every 3 years until no more polyps are found. In the case of normal findings on colonoscopy, colonoscopy is resumed after 10 years.

Clinical transition probabilities

The transition probabilities built into the models were mainly based on the publications in Asia (Table 1).[2, 16–24] The sensitivity of guaiac-based FOBT and FS for CRC varied from 25% to 60% and from 75% to 80%, respectively.[2, 16–19] We assumed a possible range of specificity for FOBT from 70% to 90% and for FS from 60% to 90%.[2] The compliance rates of FOBT varied from 74% to 82%.[20–22] As there are no references available on the compliance rates of FS and colonoscopy in Asia, we assumed the compliance rates on the screening tests at 90% in the base-case model and tested the possible range of compliance from 10% to 100% in the sensitivity analysis. The compliance to colonoscopy after a positive result on FOBT or FS was assumed to be 100%. The rate of positive results on FOBT or FS was calculated as the sum of true- and false-positive cases. The rate of polypectomy, bleeding rate, and rate of perforation in colonoscopy were assumed to be 29.63%, 0.66% and 0.2% respectively.[23, 24] The mortality because of perforation was taken as 10%.[24] Screening intervals were chosen based on the most recent set of recommendations.[25]

Without screening, the population was expected to develop CRC based on the annual age-specific incidence rates of CRC from Hong Kong, China.[26] The detection of CRC at earlier stages improves the overall survival. According to a study from Japan, FOBT can reduce the incidence of CRC by 16%.[27] No reference was found for the case reduction on CRC after annual screening by FS or colonoscopy in Asia. Therefore, we used the assumption that ES can reduce the CRC incidence by 34%, which was also the assumption of an US study.[12] According to large cohort studies such as National Polyp Study,[28] a 76–90% reduction in CRC incidence can be expected using colonoscopy screening. We assumed a 75% reduction in CRC with colonoscopy. This figure is based on the assumption of

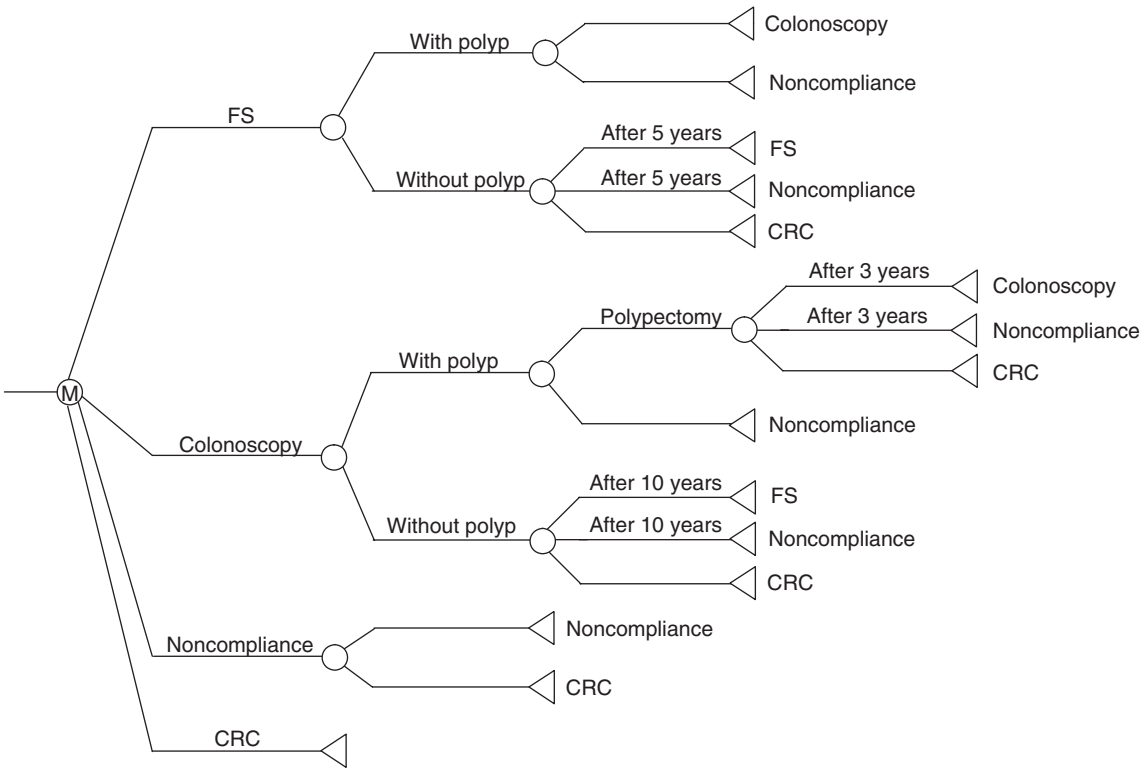

Figure 2. Markov process on strategy 2 using flexible sigmoidoscopy as primary screening procedure. Transitions of patients to different stages are described. Annual mortality was also counted in the model. Patients were followed up from years 50 to 80. FS, flexible sigmoidoscopy; CRC, colorectal cancer.

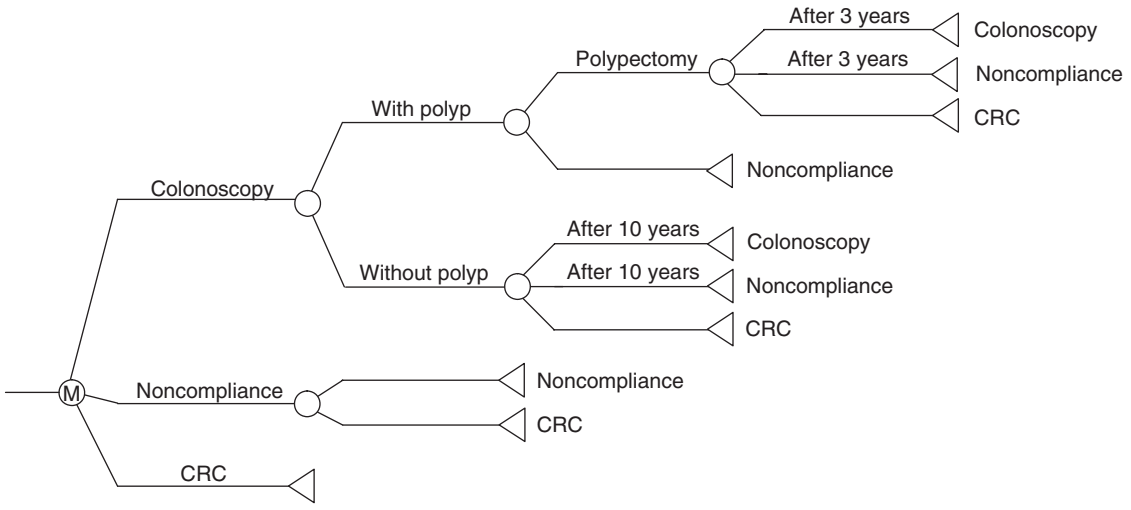

Figure 3. Markov process on strategy 3 using colonoscopy as primary screening procedure. Transitions of patients to different stages are described. Annual mortality was counted in the model. Patients were followed up from years 50 to 80. CRC, colorectal cancer.

Table 1. Baseline estimates for the screening strategies

Rate	Baseline value* (%)	Reference
Sensitivity of FOBT in detecting colorectal cancer	25.0 (25–60)	2, 16–18
Specificity of FOBT in detecting colorectal cancer	80.0 (70–90)	2
Sensitivity of FS in detecting colorectal cancer	75.0 (75–80)	2, 19
Specificity of FS in detecting colorectal cancer	76.6 (60–90)	2
Compliance rate of FOBT	90 (10–100)	20–22
Compliance rate of FS	90 (10–100)	–
Compliance rate of Colonoscopy	90 (10–100)	–
Compliance rate of Colonoscopy as the secondary screening (i.e. with a positive FOBT or polyp found in FS)	100 (50–100)	–
Rate of polypectomy	29.6	23
Bleeding rate	0.66	23
Rate of perforation	0.2	24
Morality due to perforation	10.0	24
Cancer prevented by FOBT	18	27
Cancer prevented by FS	34	–
Cancer prevented by Colonoscopy	75	–
Staging of CRC at diagnosis		
I	10	26
II	33.7	
III	36.8	
IV	19.5	
Annual mortality of CRC patients at various stages of disease		
I	0	26
II	1	
III	6	
IV	38.7	
Annual discount rate	3 (3–6)	35

FOBT, faecal occult blood test; FS, flexible sigmoidoscopy; CRC, colorectal cancer.
* Values in parentheses are the range used in sensitivity analysis.

colonoscopy with 100% compliance. After factoring in 10% noncompliance into the protocol, a discounted reduction in CRC by FS and colonoscopy is estimated to be 29% and 54% respectively.

The annual mortality rates of CRC diagnosed at different stages are based on the Hong Kong Cancer Registry.[26] Patients diagnosed with stage I and II CRC are treated with surgery alone with an intent to cure (recurrence-free for at least 3–5 years). CRC patients diagnosed with stage III disease are offered adjuvant chemotherapy after surgery. Seventy per cent of these patients are expected to be cured, but the rest develop recurrent disease and succumb. Patients with stage IV disease are offered palliative colorectal surgery followed by palliative chemotherapy. Among patients with stage IV disease, 50% of them required further surgery for liver metastasis.[29, 30] Five common regimens are available, which include 5FUFA, FOLFIRI, FOLFOX, Avastin and Cetuximab. 5FUFA is usually regarded as the first-line agent in the adjuvant and metastatic setting. However, we assumed in the base-case model that FOLFOX for 6 months and FOLFOX + bevacizumab (Avastin; Roche/Genentech Inc., San Francisco, CA, USA) for 10 months, which are currently the best and most effective chemotherapeutic agents in the adjuvant and metastatic setting, are given to the patients with stage III and IV diseases, respectively.[31–33] When the patients were 'cured' of CRC, the follow-up surveillance and the management of possible cancer recurrence were ignored in the model.

Cost estimates

All cost data are expressed in US dollars. The decision model included direct costs of screening tests, cost of investigation and staging of CRC (including CT and PET scan), cost of cancer treatment (including surgery,

Table 2. Estimates for the costs based on different screening strategies and treatment methods[30]

Cost item	Baseline value (USD)*
FOBT	$4
FS	$244
Colonoscopy	$450 ($100–$1000)
Bleeding	$3320
Polypectomy	$830
Perforation	$10 790
Treatment for the stage I or II of CRC	$16 552
CT scan	$513
PET scan	$1795
Colorectal surgery	$7148
Consultation fees (9 days)	$2596
Hospital charges (9 days)	$4500
Treatment for the stage III of CRC	$27 321 ($16 937–$27 321)
CT scan	$513
PET scan	$1795
Colorectal surgery	$7148
Consultation fees for 9 days	$2596
Hospital charges for 9 days	$4500
Chemotherapy: FOLFOX for 6 months†	$10 769 ($385–$10 769)
Treatment for the stage IV of CRC	$71 751 ($23 418–$139 591)
CT scan	$513
PET scan	$1795
Colorectal surgery	$7148
Metastatic disease on liver	$6481
Consultation fees for 9 days (up to 30 days)	$2596 ($2596–$8654)
Hospital charges 9 days (up to 30 days)	$4500 ($4500–$15 000)
Chemotherapy: FOLFOX and Avastin for 10 months†	$48 718 ($385–$100 000)

FS, flexible sigmoidoscopy; CRC, colorectal cancer, USD, US dollars.
* Values in parentheses are the range used in sensitivity analysis.
† 5FUFA for 6 months as the alternative treatment for sensitivity analysis.

chemotherapy) and cost of hospitalization (Table 2). The costs also include the possibility of hospitalization for complication (bleeding or perforation) after endoscopy and/or polypectomy. We did not include indirect costs (e.g. transportation costs to hospital or productivity lost because of absence of work) in the analysis for simplicity. All charging costs were derived from the Government Gazette fees in China.[34] The labour costs for daily hospital care and the disposable instrument were counted in the hospitalization, whereas the costs of CT and PET scan, surgical procedures and consultation were counted separately. The average period of hospital stay for patients with surgery for CRC was assumed to be 9 days.[35] The costs of chemotherapy were only considered for patients with stage III and IV diseases. The choice of treatment and length of hospital stay in stage IV patients depend on the progression of the disease and hence we proposed that the ceiling cost of chemotherapy to be $100 000 and the maximum length of hospital stay to be 30 days in the sensitivity analysis. Among the patients with stage IV disease, we assumed that 50% would require liver resection[29, 30] and the unit cost for liver resection is $12 962. The average cost for each patient was $6481. The costs of repeat visits and blood transfusions were not included in the calculation. All future costs arising from screening or care of CRC and all future life-years saved through screening are discounted at an annual rate of 3%.[36]

Cost-effectiveness analysis

Effectiveness of screening is measured in terms of life-years saved through prevention of CRC and improved survival of earlier cancer diagnosis. Years of life lost were estimated using the Hong Kong standard life table.[37] The life-years lost by the age-dependent proportions of patients dying prematurely of CRC are

accumulated for each cycle during the entire expected lifetime. The number of life-years saved because of screening corresponds to the difference in life-years lost from cancer related deaths between a Markov model with and one without screening. The main outcome of this study was the incremental cost-effectiveness ratio (ICER) between the screening strategies, i.e. the cost difference divided by the difference in effectiveness between strategies. ICER is a measurement to quantify the amount of additional cost required for a life-year saved.

Sensitivity analysis

As the health cost varies in different Asian countries, sensitivity analyses on ICER were conducted to assess their robustness across different intervals of key parameters. We computed one-way sensitivity analyses on the ICER between different screening strategies over the possible range of model variables. The compliance rates on the initial, repeated and follow-up screening were assumed to be the same. When the results are not robust, the threshold values for the change of conclusion were presented. All calculations were simulated by using Excel spreadsheets.

RESULTS

The outcomes of three screening strategies and no screening are shown in Table 3. Life-years saved and the costs associated with various items reflect the effect of an annual discount rate of 3%. Without

Table 3. Outcome of a cohort of 100 000 average-risk individuals aged 50–80 years with various screening strategies for colorectal cancer

Variable\screening strategy	No screening	FOBT	FS	Colonoscopy
Total number CRC cases	4934	3491	3104	2263
Total loss of cancer-related life years	27 060	17 693	16 054	11 155
Cases of CRC prevented	0	1443	1830	2671
Proportion of CRC case prevented (%)	0	29.3	37.1	54.1
Life-years saved	0	9367	11 006	15 906
Number of procedures				
FOBT	0	561 820	0	0
FS	0	0	358 149	0
Colonoscopy	0	155 821	115 237	310 630
Diagnostic (without polypectomy)	0	109 075	80 666	217 425
Therapeutic (with polypectomy)	0	46 746	34 571	93 182
Number of complications				
Bleeding events	0	545	403	1087
Perforations	0	156	115	311
Costs (USD)				
FOBT	$0	$1 809 582	$0	$0
FS	$0	$0	$63 050 648	$0
Colonoscopy	$0	$52 099 228	$36 715 047	$101 835 661
Polypectomy	$0	$28 799 411	$20 314 136	$56 344 839
Bleeding events	$0	$1 345 318	$948 064	$2 629 623
Perforations	$0	$1 249 224	$880 345	$2 441 793
Care of CRC				
Stage I	$4 622 304	$3 192 338	$2 855 756	$2 052 768
Stage II	$15 577 164	$10 758 178	$9 623 897	$6 917 828
Stage III	$28 077 111	$19 391 115	$17 346 625	$12 469 063
Stage IV	$39 072 444	$26 984 908	$24 139 772	$17 352 097
Total	$87 349 022	$145 629 301	$175 874 290	$202 043 672
Total costs per life-years saved	–	$15 547	$15 980	$12 703

FOBT, faecal occult blood test; FS, flexible sigmoidoscopy; CRC, colorectal cancer; USD, US dollars.

Table 4. Incremental cost-effectiveness ratios switching from strategies 1 to 2

	Strategy 2		
Strategy 1	FOBT	FS	Colonoscopy
No screening	$6222	$8044	$7211
FOBT	–	$18 458	$8628
FS	–	–	$5341

FOBT, faecal occult blood test; FS, flexible sigmoidoscopy. ICER = $6222/life-year saved.

screening, the cohort of 50-year-old subjects will experience 4934 cases of CRC and a loss of 27 060 cancer-related life-years. Screening with FOBT, FS and colonoscopy prevents 29.3%, 37.1% and 54.1% of CRCs respectively. Screening with colonoscopy results in more life-years saved and greater reduction in mortality, but at a higher cost. The treatment for advanced CRC (stage III and IV) is substantially higher. Hence, detection of cancer at earlier stages by screening leads to a reduction in both cancer mortality and treatment expenditures.

The total costs for managing CRC increase from no screening ($87 million) to FOBT ($146 million), to FS ($176 million) and to colonoscopy ($202 million). Compared with no-screening strategy, the ICER of FOBT, FS and colonoscopy are $6222, $8044 and $7211 respectively (Table 4, Figure 4). Therefore, FOBT is the most cost-effective strategy in preventing and managing CRC. ICERs of different screening strategies are related to the compliance rate. In the base-case model, the compliance rate of each screening strategy is assumed to be 90%. One-way sensitivity analysis was performed testing a range of compliance rates (Figure 5). With a reduced compliance rate, ICER would increase indicating that extra costs are required for a life-year saved. Yet, ICER remains the lowest for FOBT, compared to FS and colonoscopy. On the other hand, when the compliance to colonoscopy after a positive FOBT or FS is reduced to 50%, ICER of FOBT, FS and colonoscopy compared with no-screening are $6631, $9350 and $7211 respectively. Thus, FOBT remains the most cost-effective screening strategy to prevent and manage CRC.

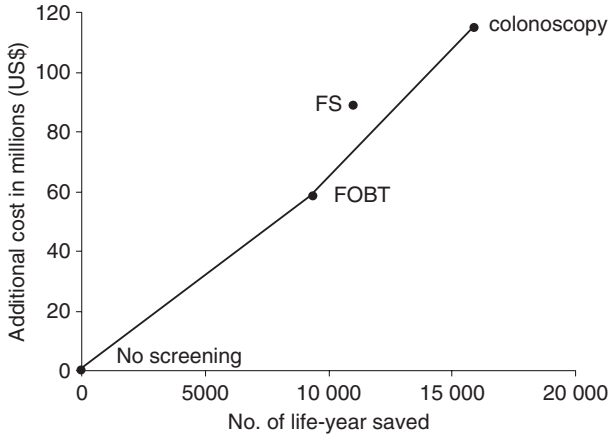

Figure 4. Cost-effectiveness analysis for the screening tests. The line drawn represents the cost-effectiveness frontier. The additional costs for a life-year saved on FOBT compared with no screening and colonoscopy compared with FOBT are $6222 and $8628 respectively. Screening by FS is costly but less effective.

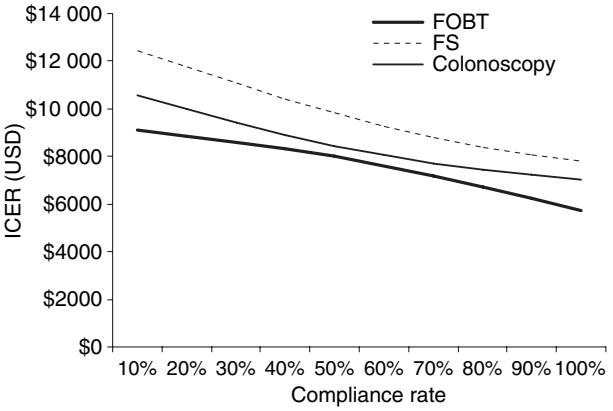

Figure 5. One-way sensitivity analysis on the compliance rate of screening tests. When the compliance rate increases, the ICER of the three screening tests will drop. FOBT always keeps the lowest ICER.

The performance of FOBT determines its cost-effectiveness rather than other screening strategies. The sensitivity and specificity of FOBT are taken as 25% and 80% respectively in the base-case model, based on a published result in China.[2] ICER of FOBT increases with decreasing specificity from 80% to 20% (Figure 6). Similarly, with decreasing sensitivity of FOBT, ICER would also increase. When the sensitivity and specificity of FOBT drop to 30–60% and 20–50% respectively, ICER of FOBT may exceed that of colonoscopy implying that FOBT is less cost-effective.

The cost of colonoscopy has little influence on the notion that FOBT is more cost-effective than direct colonoscopy as a primary screening tool. At the range of US$100 to $1000 per colonoscopy, ICER of FOBT

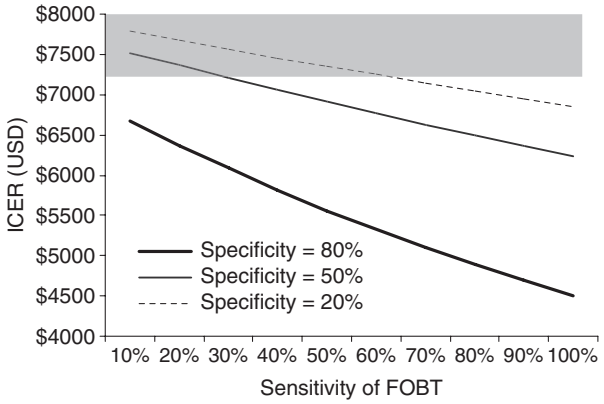

Figure 6. Two-way sensitivity analysis on the sensitivity and specificity of FOBT. Colonoscopy is more cost-effective when the ICER of FOBT is greater than that of colonoscopy (grey area). When both sensitivity and specificity of FOBT are high, the ICER of FOBT is the lowest.

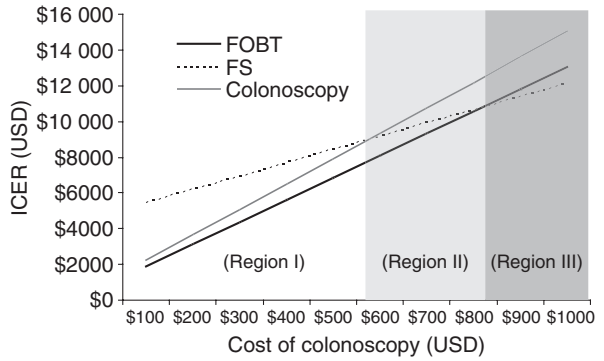

Figure 7. One-way sensitivity analysis on the cost of colonoscopy. When the cost of colonoscopy is less than $572, FOBT is the most cost-effective, while FS is the least (region I). When the cost of colonoscopy increases from $572 to $818, FOBT is the most cost-effective, while colonoscopy is the least (region II). When the cost of colonoscopy is greater than $818, FS is the most cost-effective, while colonoscopy is the least (region III).

remains lower than that of colonoscopy (Figure 7). At a fixed price of FS, the higher cost of colonoscopy for patients with a positive FS or FOBT will render FOBT less cost effective than FS as a primary screening tool.

On the other hand, a higher treatment cost for CRC will lower the ICERs. When the cost of treatment for stage IV CRC increased to $139 591, the ICERs of FOBT and colonoscopy were $7072 and $7421 respectively. The difference between the ICERs became closer, but this did not change the notion that FOBT is the most cost effective strategy for CRC screening.

Finally, ICERs increase with the discount rate. When the discount rate increased to 6%, the ICERs of FOBT and colonoscopy were $11 195 and 12 033 respectively. The difference between ICERs was enlarged, and therefore, FOBT remained more cost-effective than colonoscopy.

DISCUSSION

This study suggests that FOBT, if tested positive, followed by colonoscopy is the most cost-effective method in screening for CRC. The ICER compared against no screening is the lowest for FOBT, followed by direct colonoscopy and FS. The cost-effectiveness of FOBT over the other strategies is not sensitive to the compliance rate of screening procedures, i.e. this result holds even when the compliance rate drops from 90% to 10%. FS is the least cost-effective method of screening in our model. The assumed performance of FOBT in this study is based on published data on the guaiac-based test, which is known to be lower in sensitivity, specificity and cost per cancer detected than the immunochemical test.[38] With faecal immunochemical test, the ICER is expected to be even lower, although the test itself is slightly more expensive than the guaiac-based test. The result of our cost analysis holds for a wide range of cost of colonoscopy from $100 to $1000 per case. This is because when FOBT detects a positive case, colonoscopy is still required to confirm colonic neoplasm.

FOBT is shown to be the most cost-effective in one-way sensitivity analysis. As most of the data were based on Japan and Hong Kong studies, we had undertaken a series of sensitivity analysis to ensure that our result can extrapolate to other Asian countries. The results are robust to the change of compliance rate, sensitivity or specificity of screening tests, compliance to colonoscopy after a positive FOBT or FS, costs of colonoscopy and chemotherapy for CRC and the annual discount rate. However, when both sensitivity and specificity of FOBT are low, colonoscopy may be the most cost-effective screening method for CRC. When the cost of colonoscopy is high, FS may be the most cost-effective method.

This result is discordant with previous reports from the US. Sonnenberg *et al.*[12] showed that colonoscopy is the most cost-effective method in diagnosing and managing CRC and McGrath *et al.*[13] looked at the management of advanced colonic neoplasm and also found direct colonoscopy as the most cost-effective

method. This study is different in a number of aspects. First, our assumptions are based on data from Asian countries such as China, Japan, Taiwan and the Asia Pacific Working Group published data. Second, we tested a model of screening in patients aged 50–80 years instead of screening until death as it has been argued that screening in the very advanced age group may not be advisable.[39, 40] Third, we have incorporated the cost of new chemotherapy regimens for different stages of advanced CRC in the cost analysis. This is important as advances in chemotherapy, such as the use of oxiplatin and irinotecan-based therapy and targeted therapy using monoclonal antibodies against VGFr and EGFr for CRC in the last decade has significantly improved the survival rates, but at a cost. Fourth, we did not make any assumption on the mortality rate from CRC. Instead, our survival data are based on the statistics from Hong Kong Cancer Registry. Among these differences, it is the cost of treatment of advanced cancer that would most likely account for the difference in the outcome.

A study from Australia, which was modelled for a hypothetical cohort of 1000 subjects offered or not offered the screening, found that the cost per life-year saved was $24 660.[41] The efficacy of screening in this study was based on the Minnesota study.[42] In this study, however, the results are sensitive to the cost of colonoscopy at $400 per colonoscopy and the false-positive rate of FOBT. The authors concluded that whether the benefits of CRC screening outweigh the harm and costs needs to be substantiated before more resources are committed to mass screening. Two studies from Asia Pacific region have studied the cost-effectiveness of CRC. Using a dynamic decision analysis model, a study from Singapore concluded that any screening strategies would increase life expectancy of the 50- to 70-year-old population, but FOBT is found to be most cost-effective.[43] A study from Korea compared the cost-effectiveness of 16 different screening strategies including the use of colonoscopy, FOBT and FS at various intervals and combinations.[44] While the aim of the study was to investigate which strategy can improve compliance of the public for screening, the authors concluded that colonoscopy performed every 5 years is an effective and cost-saving strategy in the average risk population in Korea. None of these studies has taken into account the cost of treatment based on different stages of diagnosing CRC.

We have not included newer screening modalities such as CT colonography, stool DNA test and capsule colonoscopy. The technology of CT colonography is not widely available in Asia and in the upcoming Asian Pacific Consensus on Colorectal Cancer this test has not been included. On the other hand, stool DNA test and capsule colonoscopy are still in the experimental phase and they are not ready to be recommended as a routine screening test. We recommend the cost-effectiveness analysis to be updated when new technology has developed and proved to be useful in clinical practice.

In conclusion, annual FOBT offers the most cost-effective way of screening and prevention of CRC. This finding is robust to the sensitivity analysis of compliance rate. FOBT should be recommended as the first choice of colorectal screening in Asia.

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