MODELLING COSTS AND OUTCOMES OF EXPANDED AVAILABILITY OF EMERGENCY CONTRACEPTIVE USE IN BRITISH COLUMBIA

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ABSTRACT

Background
Emergency contraception (EC) can potentially reduce unwanted pregnancies and abortions. However, these agents are underused due to lack of awareness and barriers to utilization. While earlier economic evaluations have indicated that use of EC is potentially cost-effective, recent evidence of a lower risk of pregnancy following unprotected intercourse than previously reported suggest prior studies may have over-estimated cost savings.

Objectives
To model cost savings and pregnancy-related outcomes associated with the policy change authorizing pharmacist provision of EC in British Columbia, and to estimate the costs of initiatives to further women's awareness and utilization of EC that would result.

Methods
Three decision analytic models were developed evaluating current EC utilization (physician-only), EC utilization following pharmacist provision and potential expanded EC awareness and utilization following a public awareness initiative. Models were developed from the Ministry of Health perspective for 2001 using cost and event data from the Ministry supplemented by data from the literature.

Results
Current EC utilization saved the Ministry $2.20 million (95% CR: $0.15 million, $4.90 million) in medical costs the first year, and incremental savings from pharmacist provision was $0.64 million (95% CR: $0.24 million, $1.28 million). A public awareness initiative costing less than $2.57 million (95% CR: $0.22 million, $5.75 million) annually is potentially cost saving.

Conclusions
Pharmacist provision of EC was cost saving to the Ministry, even when the estimated risk of pregnancy in the population is less than assumed in previous studies. Increasing EC availability directly from pharmacists and increasing EC awareness have the potential to reduce health care costs.

Keywords: *Emergency contraception, levonorgestrel, Yuzpe regimen, morning after pill, cost savings, unintended pregnancy*

Unintended pregnancy and subsequent induced abortion are major public health issues that have high costs to the individual, government, and society.[1-4] Of the 58,678 total pregnancies that occurred among women 15- 44 years of age in British Columbia in 2001, 13,696 (23.3%) of the

pregnancies ended with an induced abortion. Emergency contraceptives (ECs) are a safe and effective, but underused, postcoital contraceptive method when started within 72 hours of unprotected intercourse.[5-7] As ECs are effective at preventing unintended pregnancies, several studies have demonstrated that emergency contraception (EC) saves health care costs.[8-11] However, these studies assumed an estimate of the risk of pregnancy following unprotected intercourse[5] that has been substantially revised downward in recent years.[12] Thus, these past investigations may have over-estimated cost savings from utilization of EC. In December 2000, British Columbia was the first Canadian province to initiate a change in public health policy that granted trained, certified pharmacists authority to provide ECs without a physician's prescription.[13] This change resulted in a 102 percent increase in the number of EC treatments prescribed in 2001. During the first two years after the policy change, data were obtained that enabled us to estimate the risk of pregnancy among women seeking EC in British Columbia (overall risk of pregnancy 4.12%).[12] The objectives of the present study were to: estimate the Ministry of Health savings in health care costs as a result of EC utilization in the province in 2001; estimate cost savings from expanding access to EC through certified community pharmacists; and estimate the costs of initiatives to further women's awareness and utilization of EC and whether that would result in net cost savings to the province.

METHODS

Overview

Decision-modelling techniques were employed to estimate costs and outcomes of EC use when women obtained the combined hormonal Yuzpe regimen of ethinyl estradiol-norgestrel regimen (Ovral®, Preven®) or levonorgestrel regimen (Plan B®) from a physician or pharmacist, following unprotected intercourse. Outcomes of interest included the incremental difference in the incidence of unintended pregnancy (in terms of total pregnancies, induced abortions, births, spontaneous abortions, and ectopic pregnancies avoided), and the incremental difference in costs for different EC provision policies as well as the maximum allowable cost for a public awareness initiative to increase EC awareness and usage.

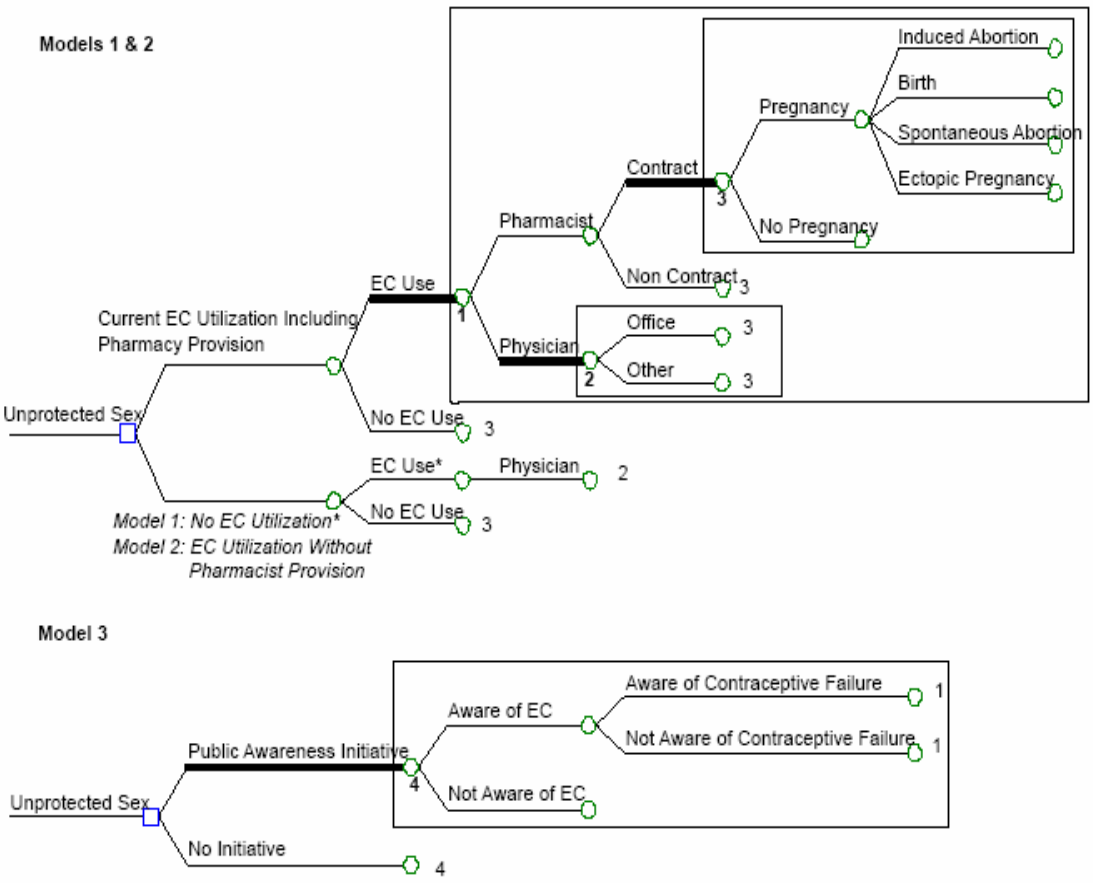
Results are expressed from the perspective of the Ministry of Health with a one-year time horizon. Costs have been converted to 2001 Canadian dollars. Average direct medical costs were used for costs associated with the outcomes of unintended pregnancies, and physician and pharmacist services. Implementation costs for the policy change were excluded, as were costs of a public awareness program, so that cost savings derived from increasing awareness and usage would be indicative of how much could be spent on a public awareness initiative and still be cost neutral. Due to the one-year time horizon, we did not discount costs and outcomes.

Model Structure

Three decision-model analyses of increasing complexity were used to estimate the expected incidence of unintended pregnancy and incremental costs of EC utilization patterns under comparison. Model 1: Current EC utilization versus no EC utilization; Model 2: EC utilization following implementation of the pharmacy provision policy versus predicted EC utilization had the policy change not occurred; and Model 3: Expanded EC awareness and utilization versus current EC utilization. In this model, physician and pharmacist provision were both included. All three models were run with the British Columbia estimated conception risk of 4.12% as the base case.[12] Scenario analyses were also performed using the World Health Organization (WHO) conception risk of 7.5%.[7] According to all three models, once a woman has unprotected intercourse, she can either obtain EC or not, and if she has obtained EC, it can be from one of several types of providers. Location of EC provision appears to influence the type of EC, as pharmacists were providing the more effective Plan B® than physicians. Location also appeared to affect the time after unprotected intercourse that EC is obtained, as pharmacies are more often open on weekends and holidays than are physician offices. Together, these factors would be expected to influence EC effectiveness. If the woman becomes pregnant she may have an abortion, birth, spontaneous abortion, or ectopic pregnancy (Figure 1). In Model 3, the probability of a woman going to an EC provider is dependent on

her awareness of EC. To expand EC utilization, awareness may be raised thus increasing usage; awareness may stay the same, but aware women may be more likely to seek EC thus increasing usage; or a combination of increased awareness and usage among aware women may occur. In the base case analysis, we assumed both increased awareness and usage rate among aware women.

FIG. 1 Decision Tree for EC Utilization Patterns in Models 1 - 3



Model 1: Current EC utilization (physician prescription only) versus no EC utilization
* For Model 1, there is no EC utilization at this node.
Model 2: EC utilization following implementation of pharmacy provision policy (physician and pharmacist prescriptions) versus predicted EC utilization had policy change not occurred (current EC utilization)
Model 3: Expanded EC awareness and utilization versus current EC utilization

Model Parameters

The model parameters consist of probabilities of conception, pregnancy outcomes and EC use, EC effectiveness, and costs parameters. Values for the base case analysis and range of values used in the sensitivity analyses are shown in Table 1. Values were estimated from a combination of published studies and British Columbia-specific data.[14-22]

TABLE 1 Base Case Parameters Used for One-way Sensitivity and Multivariate Analyses with Ranges and Source of Parameter Values

PARAMETER	Base Case	Range	Source
Conception risk	0.04	0.03 – 0.09	[12]
Proportion of sex acts using EC in 2001*	0.07	0.05 – 0.28	[1,2,12,14,15]
Proportion of EC use predicted if no pharmacy policy	0.05	0.04 – 0.22	[13]
Pregnancy Outcomes†			
Birth	0.40		[1]
Induced abortion	0.46		[1]
Spontaneous abortion	0.12		[16]
Ectopic pregnancy	0.01		[16]
EC Effectiveness (RR) Parameters			
Combined hormonal regimen	0.58	0.38 – 0.78	[7]
Progestin only	0.18	0.09 – 0.23	[7]
Both (weighted by population usage)	0.52	0.38 – 0.78	[7]
EC Utilization Parameters			
Proportion of women using pharmacists (non-contract)	0.11	0.00 – 1.00	BC data
Proportion of women using pharmacists (contract)	0.02	0.00 - 2.25	BC data
Proportion of women using physicians	0.72	0.54 – 0.90	BC data
Proportion of women using public health/youth clinics/Options for Sexual Health/emergency room	0.15		BC EC Surveys
EC Cost Parameters			
Physician costs	$23	$17-29	[17]
Pharmacist counselling (contract)	$15	$11-19	BC data
Non-contract pharmacist costs to MOH	$0		
Average cost to MOH for EC not prescribed by pharmacists or in physician's offices	$18	$14-23	[17]

Pregnancy Cost Parameters			
Birth	$5,112	$5088-5136	BC data
Induced abortion	$913	$906-920	BC data
Spontaneous abortion	$1,528	$1499-1557	BC data
Ectopic pregnancy	$3,587	$3487-3686	BC data
Increased Utilization Parameters‡			
Awareness (initial)	0.57	0.43 – 0.71	[16]
Increase in awareness	0.28	0.00 – 0.43	[18]
Knowledge of contraceptive failure	0.49	0.34 – 0.79	[19 - 22]
Initial use of EC among women who were unaware of contraceptive failure	0.00		
Increased utilization among women aware of EC (absolute)	0.1	0 – 0.25	estimate

* The proportion of all sex acts in which women were at risk of unintended pregnancy and they used EC.
† May not add up to 1.00 due to rounding.
‡ Used only in Model 3
BC = British Columbia; EC = emergency contraception; MOH = Ministry of Health;
MSP = Medical Services Plan; RR = relative risk; Stats = Statistics; WHO = World Health Organization

EC Use and Effectiveness

To determine the impact of current and expanded EC use, we estimated the number of acts of unprotected intercourse in British Columbia at risk of unintended pregnancy among women who were candidates for EC utilization. The total number of acts of unprotected intercourse at risk was the sum of EC users and the estimated number of acts of unprotected intercourse at risk in which EC was not used. In 2001, this was estimated to be 720,820 (details of this calculation can be provided upon request). The latter was estimated by determining the total number of unintended pregnancies in 2001 (pregnancies in British Columbia[1] multiplied by a published estimate of the proportion of those pregnancies that were unintended),[2] subtracting the estimated number of pregnancies that occurred among EC users,[14, 15] and dividing the remaining pregnancies by the risk of conception following unprotected intercourse.[12]

Pharmacists were one of the sources of EC in the province, and pharmacies could be either contract or non- contract. In contract pharmacies, the Ministry of Health paid counselling fees of $15 for each pharmacist-provided EC treatment, while in non-contract pharmacies the EC user paid the fee. Other EC sources included physicians, both as prescriptions and office supplies at no charge to the woman; emergency departments; Options for Sexual Health (previously Planned Parenthood); student medical services; youth clinics; public health units; and sexual assault programs.

To estimate the amount of EC utilization in the absence of pharmacist provision, the amount of EC provided in 2001 by emergency departments, sexual assault programs, student medical services, public health units, youth clinics and physician office supplies was added to the amount of EC that we predicted would be obtained from physician prescriptions and Options for Sexual Health. A regression model was built to predict how much EC would be prescribed in 2001 by physicians and Options for Sexual Health based on 1996-2000 data, as these were the only two sources for which complete EC prescribing

information was available for the years of interest. Based on the regression analysis, the number of predicted EC treatments if pharmacists had not prescribed EC in 2001 was 37,929.

We weighted published estimates of EC effectiveness[14] for both the combined hormonal and levonorgestrel regimens by the proportion of women obtaining each regimen based on 13,178 treatment consents from EC users.[13] As type of EC obtained varied according to provider type, effectiveness of the EC also varied in proportion to where it was obtained. Consents for treatment[13] and PharmaNet (a linked database of prescriptions administered by the Ministry of Health) drug data[13] provided information about the magnitude and type of EC women obtained from pharmacists, both contract and non contract; physicians, both those who prescribe EC and those who provide it from office supplies at no charge;[23] public health and youth clinics; student medical services; Options for Sexual Health; sexual assault programs; and emergency departments in 2001.

Pregnancy Outcomes

Assuming that 49% of pregnancies are unintended,[2] we calculated the probability of the outcomes of interest: pregnancies, induced abortions, births, and spontaneous abortions from the British Columbia Vital Statistics Agency[1], and ectopic pregnancies from literature-based estimates.[24]

EC Costs

Costs for a user to obtain EC included the cost of the EC agent, and dispensing and consultation/ counselling fees. Counselling fees varied according to where the EC was obtained. Consultation/counselling costs for providing EC were funded by the Ministry of Health when EC was prescribed by a physician or by a pharmacist employed in a community pharmacy that has a $15 counselling fee contract with the Ministry. Costs for pharmacies that do not have a contract with Ministry were not included since the women pay directly for the service. The Ministry was billed $23[17] for each woman who obtained an EC prescription from a non-specialist physician office visit, including physicians at student medical service clinics. The cost to the Ministry of an emergency room visit to obtain EC is dependent on time of day and day of week;[17] we assumed an average cost. In youth and public health clinics, nurses, not doctors, see patients. At Options for Sexual Health, either a physician (80% of visits) or a nurse (20% of visits) may provide EC (personal communication, Greg Smith). Since the Ministry does not reimburse for nurse visits, these visits were assigned a cost of $0.

Birth Costs

We estimated average direct medical costs of unintended pregnancy-related outcomes (pregnancies, induced abortions, births, spontaneous abortions, and ectopic pregnancies) occurring in fiscal year 2001-2002 using Hospital Separations[13] and Medical Services Plan[17] data. Costs of all pregnancy-related care such as outpatient visits, lab work, radiology care, and hospitalization were included for each pregnancy from conception to outcome of the pregnancy.

Awareness of EC and Contraceptive Failure

Awareness of contraceptive failure is crucial in provision of EC. In these models, we used the results of Lewis *et al.*[19] who found that 49% of women in their study were aware of non-use or failure of contraception at time of unprotected intercourse and were thus suitable for EC use. Awareness of EC was based on a 2002 study of Canadian contraception.[16] Estimates of impact of a public awareness initiative were based on a study of the Emergency Contraceptive Hotline (1-888-NOT-2-LATE), which found an approximately 28% increase in EC awareness.[18] We have also assumed a 10% increase in EC usage among women who are aware of EC.

Scenario and Sensitivity Analyses

Probabilistic multivariate sensitivity analyses were conducted using @Risk software (Palisade Corporation, Newfield, NY). Reported 95% confidence ranges (CR), based on multivariable modelling with Monte Carlo simulations, provide a plausible range within which we are confident that the true value of cost savings is contained, given the assumptions made. We used the normal distribution for cost parameters, log normal for relative risks, and triangular distributions for all other inputs. Using the sensitivity function in @Risk, we determined the most influential parameters for cost difference between EC policies. We then conducted one-way sensitivity analyses for

these influential parameters. We performed two scenario analyses to determine the impact of specific assumptions: 1) the impact of using the WHO trial's conception risk estimate of 7.5%[7] which is widely cited in the literature, as opposed to the conception risk estimated in British Columbia of 4.12%,[12] and 2) the impact of an awareness initiative looking at an increase in either EC awareness or utilization alone among women who are aware of EC (Model 3).

Ethics

Ethics approval was obtained from the UBC Clinical Research Ethics Board (C03-0026) and data access approval from the Health Information Access Centre, British Columbia Ministry of Health.

RESULTS

In the current EC utilization versus no EC utilization (Model 1), EC utilization was estimated to save the Ministry of Health $2.20 million (95% CR: $0.15 million, $4.90 million) in 2001 (Table 2). Use of EC was estimated to be associated with a reduction in pregnancies, induced abortions, births, spontaneous abortions, and ectopic pregnancies of 0.17%, 0.08%, 0.07%, 0.02%, and <0.01%, respectively. As shown in Figure 2a, the variables that most influence the difference between cost of current EC utilization and no EC utilization were the proportion of acts of unprotected intercourse at risk using EC, risk of conception in the absence of EC, effectiveness of EC, proportion of women using pharmacists, proportion of unintended pregnancies, and amount of EC provided from physician office supplies at no charge. The sensitivity analysis indicates that even when these variables are set at the least favourable level for current EC utilization, current EC utilization is cost saving for the Ministry compared to no EC utilization. The scenario analysis assessing the WHO conception risk of 7.5% found a $5.05 million cost savings from EC use, and a reduction in pregnancies, induced abortions, births, spontaneous abortions, and ectopic pregnancies of 0.36%, 0.16%, 0.14%, 0.04%, and <0.01%, respectively.

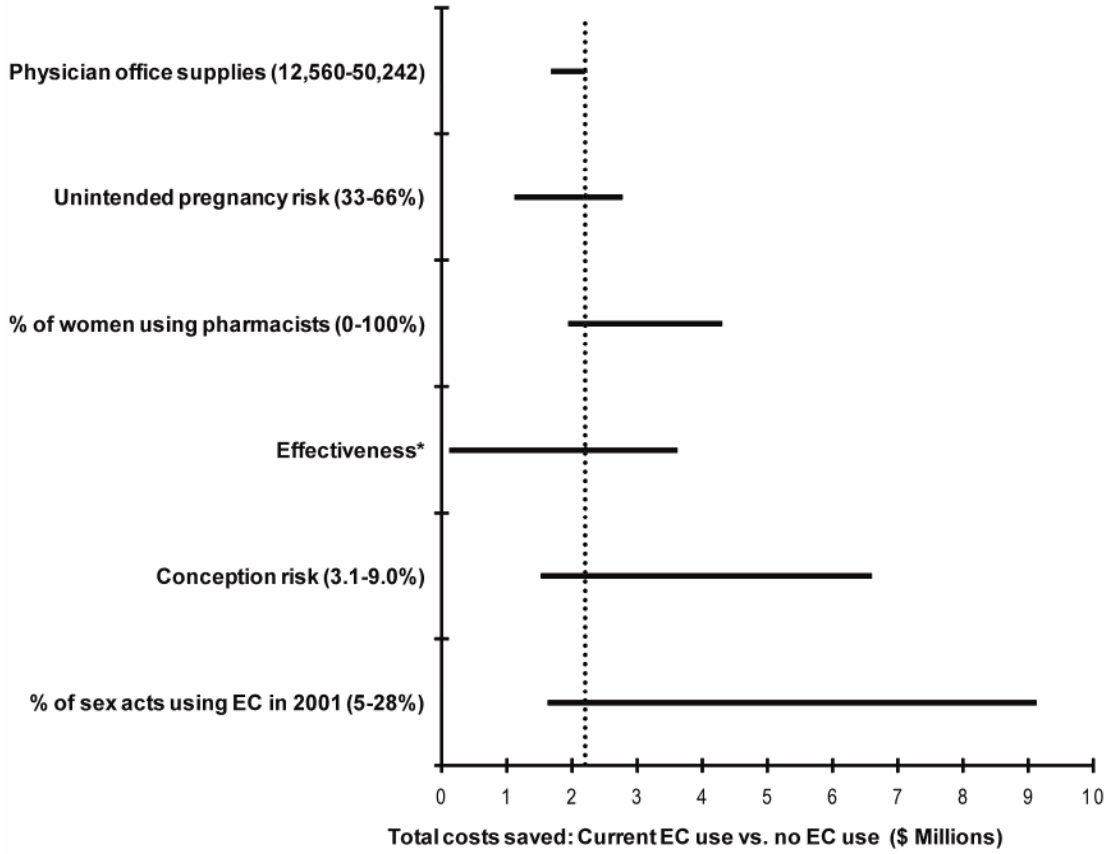
TABLE 2 Estimated Cost Savings for EC Utilization Patterns in Models 1 - 3

Model 1	Total Cost Savings	95% CR
Current EC utilization versus no EC utilization	$2,197,097	$148,629 - $4,903,088
Model 2	**Total Cost Savings**	**95% CR**
EC utilization following implementation of the pharmacy provision policy versus predicted EC utilization had the policy change not occurred	$694,592	$239,739 - $1,284,253
Model 3	**Total Cost Savings**	**95% CR**
Expanded EC awareness and utilization versus current EC utilization		
Increased awareness	$1,079,467	$71,672 - $2,464,825
Increase utilization	$1,012,861	$48,305 - $2,392,133
Combined impact of both increased utilization and awareness*	$2,570,233	$217,911 - $5,748,262

CR = Confidence Range

* The combined impact exceeds the individual parameters of increased EC awareness and increased EC utilization due to the synergy between the two parameters in the model.

FIG 2a One-way Sensitivity Analyses for Model 1: Current EC utilization versus no EC utilization



In the pharmacy provision versus no pharmacy provision (Model 2), changes in pregnancy outcomes and medical costs were estimated to accrue cost saving to the Ministry of $0.64 million (95% CR: $0.24 million, $1.28 million) in 2001 (Table 2). Estimated reductions in pregnancies, induced abortions, births, spontaneous abortions, and ectopic pregnancies were 0.04%, 0.02%, 0.02%, <0.01%, and <0.01%, respectively, over those that would have occurred if pharmacists had not provided EC. The most influential variables for this model were the same as for Model 1; and as in Model 1, the sensitivity analysis showed that under all of these conditions, pharmacist provision of EC was cost saving (Figure 2b). The scenario analysis assessing the WHO conception risk of 7.5% found a $1.53 million cost savings from EC use, and reduction in pregnancies, induced abortions, births, spontaneous abortions, and ectopic pregnancies of 0.09%, 0.04%, 0.03%, 0.01%, and <0.01%, respectively.

Model 3 evaluated two interconnected outcomes of a public awareness initiative: an increase in EC public awareness and an increase in EC utilization among women aware of EC. In the base case analysis of the combined increase in EC awareness and utilization, a public awareness initiative costing less than $2.57 million (95% CR: $0.22 million, $5.75 million) annually would be cost saving for the Ministry by reducing unintended pregnancies and associated outcomes. Under this scenario, increased EC awareness and utilization led to a reduction in pregnancies, induced abortions, births, spontaneous abortions, and ectopic pregnancies of 0.19%, 0.09%, 0.08%, 0.02%, and <0.01%, respectively (Table 2). If we assume a 28% increase in public awareness of EC, but the same rate of utilization, a public awareness initiative costing less than $1.08 million (95% CR: $0.07 million, $2.46 million) annually would be cost saving. A 10% increase in EC utilization by women who were already aware of EC, but without a concomitant increase in awareness of

EC in the population would render a campaign costing less than $1.01 million (95% CR: $0.48 million, $2.39 million) cost saving. The most influential inputs to the model were: risk of conception; proportion of acts of unprotected intercourse at risk using EC; increase in utilization due to the public awareness initiative; EC effectiveness; and percent of women visiting pharmacists (Figure 2c). As in Models 1 and 2, at no value of the parameters in the one-way sensitivity analysis would the awareness initiative increase costs to the MOH. The scenario analysis using the WHO conception risk of 7.5% found a campaign costing less than $4.41 million would be cost saving; and pregnancies, induced abortions, births, spontaneous abortions, and ectopic pregnancies were reduced by 0.31%, 0.14%, 0.12%, 0.04%, and <0.01%, respectively.

FIG. 2b One-way Sensitivity Analyses for Model 2: EC utilization following implementation of the pharmacy provision policy versus predicted EC utilization had the policy change not occurred

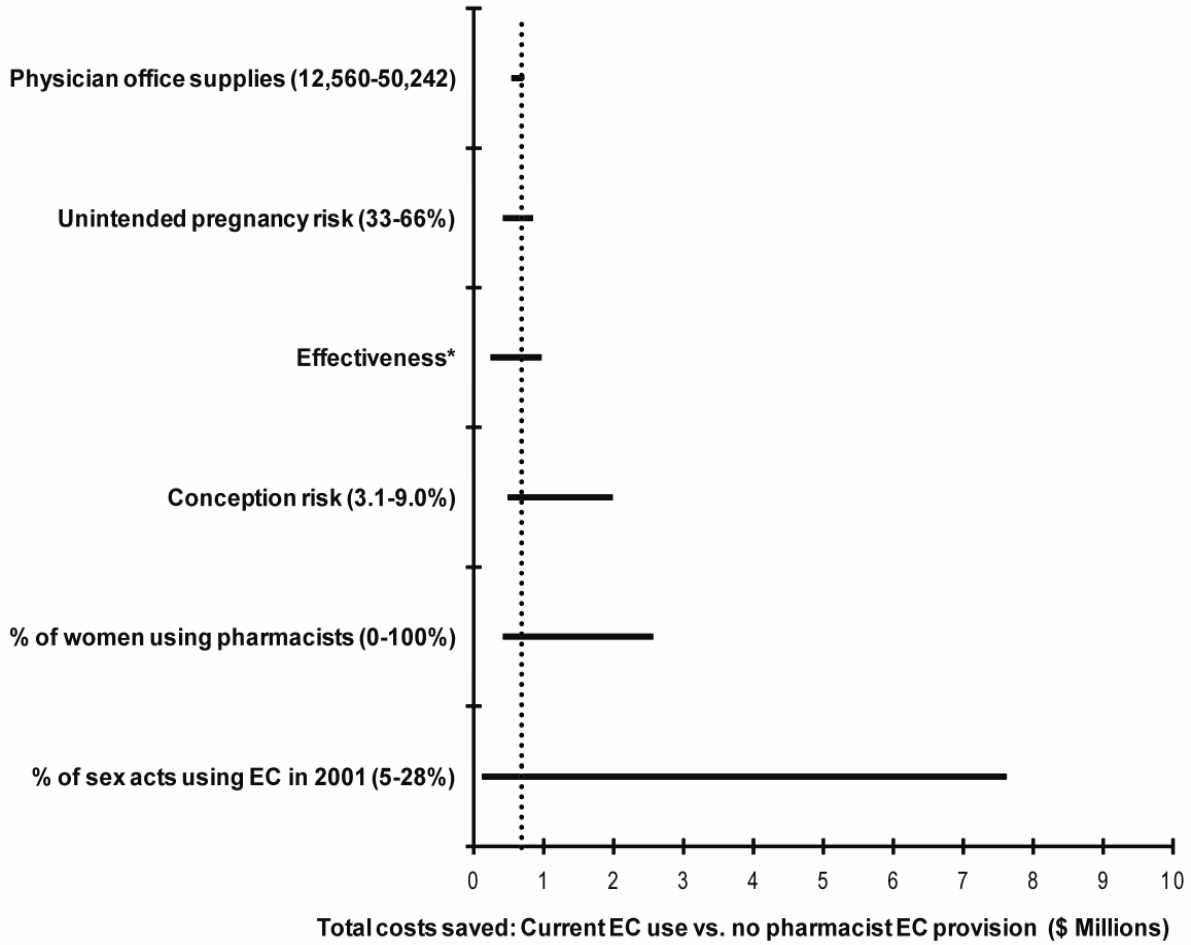
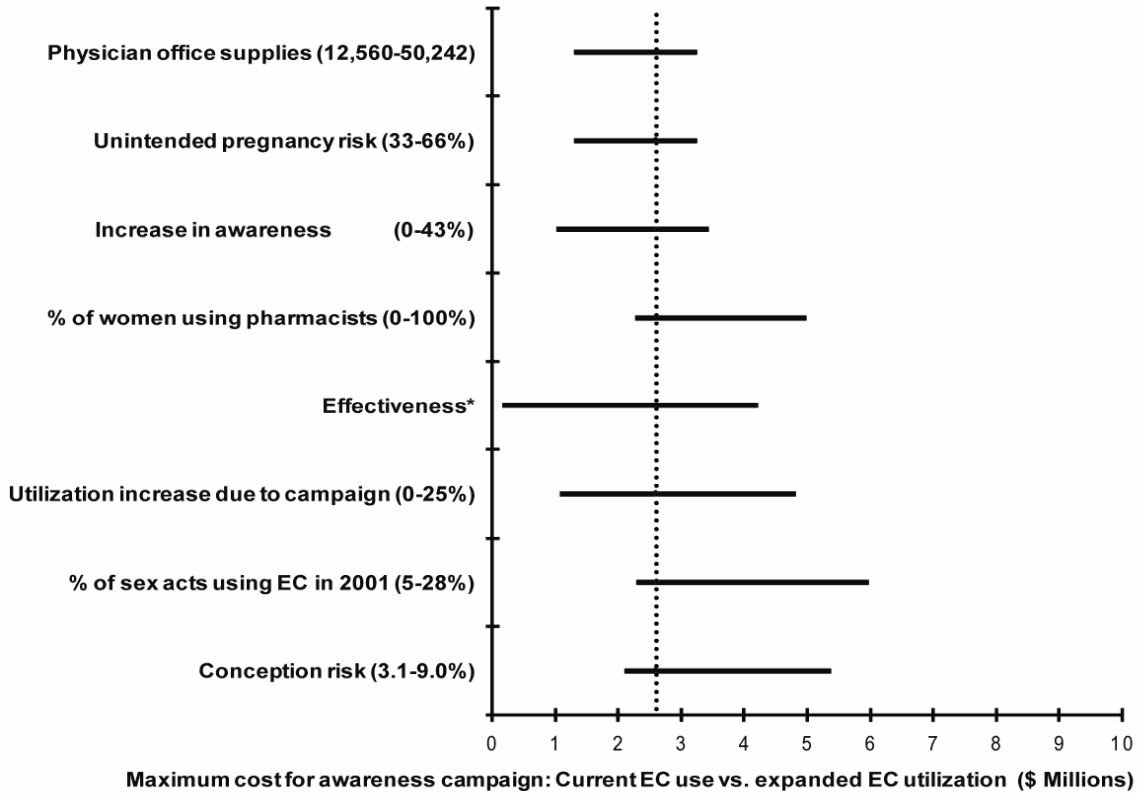


FIG. 2c One-way Sensitivity Analyses for Model 3: Expanded EC awareness and utilization versus current EC utilization



DISCUSSION

Increasing availability of EC is a cost-saving public health initiative that reduces the direct medical costs of unintended pregnancies. Using the British Columbia-specific risk of conception (4.12%) and effectiveness data, outcomes of the decision analysis models indicate that ECs are cost saving under a variety of scenarios. Model 1 indicates that providing EC at the patterns of utilization in 2001 saved an estimated $2.2 million compared to no EC provision. Model 2 indicates that the health policy that expanded access to EC through community pharmacists increased EC utilization and saved from $0.24 million to $1.28 million in direct medical costs. While most of the estimated cost savings was achieved by increased usage of EC, a small proportion was due to cost shifting from the Ministry of Health to privately paying women who obtained EC. Pregnancy events were also reduced because pharmacists provided the more effective levonorgestrel EC more frequently than physicians. Model 3 estimates that a province-wide health care professional and public awareness initiative costing less than $2.57 million (95% CR: $0.22 million, $5.75 million) aimed at increasing EC awareness and utilization could be cost saving in the first year. While the confidence range for this estimate is fairly wide (Table 2), Figure 2b illustrates the impact that increasing the percent of women accessing EC through pharmacists above the 2001 rate could have on cost savings.

These analyses demonstrated cost savings

within the Canadian health care system. Previous economic evaluations have demonstrated that: EC is cost-effective whether provided when the emergency arises or in advance to be used at a later time;[8] cost savings from EC are realized under the constraints of both American and Canadian health care systems;[9] and obtaining EC directly from a pharmacist reduces the number of unintended pregnancies and is cost saving.[10] These earlier economic analyses assumed a conception risk of 7.5% from the WHO study.[5] Since then, revised estimates among women seeking EC based on day in the menstrual cycle have resulted in downward estimates of risk of pregnancy.[12, 15, 25] With these reduced estimates of pregnancy risk, the calculated effectiveness of EC is consequently reduced and suggests that cost savings described in previous economic evaluations may have been overstated.[12,25] The current research is the first to evaluate cost savings of widespread EC use under the assumptions of the risk of conception and EC effectiveness under conditions of usual care, which are lower than earlier estimates. While the CRs for estimates from the three models are large, all inputs in the multivariate sensitivity analysis that determined the CRs were varied widely. In the scenario analyses and one-way sensitivity analyses, under no circumstance did increased utilization of EC cost more than lower utilization rates.

Several cautions are in order when interpreting our results. Some parameters in the models were estimated due to lack of data in the medical literature. EC usage as a proportion of acts of unprotected intercourse at risk is unknown, and probably unknowable. This parameter is highly influential to the models, so we varied this input widely to capture the uncertainty. Provision of ECs from physician office supplies is not recorded by PharmaNet or the Ministry of Health; and therefore, it was estimated based on surveys of physician's offices.[23] Since provision from physician office supplies affects the total amount of EC distributed, potential inaccuracies in this estimate also affect the ratio of EC use to non-use. Consequently, the input range of this variable was varied widely from 50% to 200% of the estimated 25,121 EC treatments to be provided without a prescription from physician offices. As estimates of Canadian unintended pregnancy rates are not available, we used United States data as the best estimate available. In Model 3, we assumed that women who are aware of EC are as likely as other women to engage in acts of unprotected intercourse or have a contraceptive failure. However, women aware of EC are likely to be better informed generally about reproductive health issues, to use more effective methods of birth control, and may be less likely to engage in unprotected intercourse. If this is the case, then we have overestimated the proportion of women who are candidates for EC use. Women who are aware of EC, but have a known contraceptive failure, do not always seek EC. We have assumed that this proportion remains constant, and as awareness increases, overall EC usage also increases. All of these limitations have been addressed by varying these parameters in sensitivity analyses. Additionally, by adopting a one-year time horizon, Model 3 does not take into account that in years after the public awareness initiative, there may be residual EC awareness, allowing for lower cost public awareness programs in later years.

CONCLUSION

After completion of this study, Health Canada transferred the levonorgestrel EC agent from prescription to non-prescription status; with access directly from a pharmacist.[26] The recent change in federal policy does not negate the cost savings described in this model. If women increase access to Plan B from pharmacists rather than physicians, this would further increase savings to the Ministry of Health, as pharmacists will not be charging for a medical office visit. This effect may be mitigated to some extent if women of limited financial means increasingly go to physicians for prescription of the Yuzpe regimen, if they are unable to pay the out-of-pocket cost of Plan B® from pharmacists (approximately $39). Although the policy change has led to different funding approaches in the various provinces, given the funding model in British Columbia and the similarities of the health care system across Canada, it is likely that efforts to increase women's knowledge and awareness in other Canadian jurisdictions could also be cost saving to the provincial payers, but this would need to be investigated further.

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