Programme for Research & Capacity Building
in Sexual & Reproductive Health &
HIV in Developing Countries

Research Briefing

No. 2, January 2010

Costs of cervical cancer screening in Ghana

Summary

- **Background**: Visual inspection of the cervix with acetic acid (VIA) combined with cryotherapy is one of the management strategies advocated to achieve a reduction in invasive cervical cancer (ICC) mortality in developing countries. Policymakers and researchers need information on costs of VIA and cryotherapy in order to plan for successful scale-up of ICC management programmes, and to estimate the cost-effectiveness of these and alternative prevention strategies.
- **Objectives**: To estimate 1) the costs of VIA and cryotherapy at existing VIA/cryotherapy sites in Ghana, and 2) the resource requirements for scaling up to a national screening and management programme.
- **Methods**: Resource-use data were collected at four out of six active VIA screening centres in Ghana and unit costs were ascertained in order to estimate the costs per woman of VIA and cryotherapy. Modelling and sensitivity analysis were used to explore the influence of observed differences between screening facilities on estimated costs, and to calculate national scale-up costs.
- **Findings**: The number of women screened per provider and treated per facility per year were the most important determinants of costs per woman of VIA and cryotherapy. Estimated national scale-up costs showed high variation depending on screening and management strategy and cost scenario.
- **Conclusion**: Policymakers and researchers need to pay attention to the specific determinants of costs and should consider that economies of scale may exist when planning for the scale-up of VIA and cryotherapy in Ghana.

Background

Cervical cancer is a major public health problem in developing countries [1]. Approximately 80% of cases worldwide occur in developing countries, where cervical cancer accounts for 15% of female cancers compared with just 3.6% in developed countries [1].

Human papillomaviruses (HPV) are the major cause of most cervical cancers. Vaccines against HPV are promising for the primary prevention of cervical cancer, but the question of how to improve screening coverage remains central to achieving reductions in female cancer mortality in the short term. A single visit approach consisting of visual inspection of the cervix with acetic acid (VIA) followed by immediate cryotherapy[i] for all eligible women is one of the internationally recommended screening strategies for developing countries [2]. However, in order to inform resource allocation and to plan for the scale-up of screening, policymakers need reliable estimates of the costs and cost-effectiveness of VIA and cryotherapy.

[i] Abnormal tissue on the cervix temporarily appears white when exposed to the acetic acid. Cryotherapy destroys the abnormal tissue by freezing it.

The Programme for Research & Capacity Building in Sexual & Reproductive Health & HIV in Developing Countries is a research programme consortium with core funding from the UK Department for International Development (DFID). For further information, please see our website: http://www.lshtm.ac.uk/dfid/aids/

Research methods

Data on resource use were collected at four out of six active VIA screening centres in Ghana (Ridge, Kumasi South, Sepe Dote and Komfo Anokye Teaching Hospital). Unit costs were determined from market prices and other sources of information.

A model was constructed to test the influence of observed differences between surveyed facilities and providers on estimated costs. The model calculated costs for a base case scenario (of buildings, equipment, staff, supplies, maintenance – see Technical Appendix for details) and tested the influence of alternative assumptions for input parameters (e.g. time per screening, number of women screened per year) through sensitivity analyses. Costs for a national cervical cancer screening programme in Ghana were calculated for different scenarios of coverage and screening strategy (100% and 70% coverage, screening once in a lifetime or every five years) based on derived cost estimates per woman.

Costs at surveyed facilities

Figures 1 and 2 present estimated incremental economic costs per woman screened with VIA and treated with cryotherapy. Only three of the four facilities visited were performing VIA on survey days (Figure 1), and only two facilities had functioning cryotherapy equipment (Figure 2).

Costs at surveyed facilities ranged from 7.30 to 21.86 GHS (4.93 to 14.75 US$) for VIA, and from 70.04 to 125.19 GHS (47.26 and 84.48 US$) per woman treated with cryotherapy. Salary costs accounted for the largest share of incremental costs of VIA at all facilities (45-61%). Equipment (cryoguns and probes) was responsible for the largest share of costs of cryotherapy.

Costs per woman under varying assumptions

Under base case parameter assumptions (i.e. 17 minutes per VIA screen, 600 VIA screens per nurse per year etc. – see Technical Appendix), the costing model estimated VIA costs per woman to amount to 8.91 GHS (6.01 US$). Sensitivity analyses showed that the time spent per woman screened and the number of women screened per provider were the most important determinants of costs of VIA. Costs of cryotherapy were estimated to be 41.31 GHS (27.88 US$) under base case assumptions. The number of patients treated per provider (5–60 patients/provider) and the working life of cryotherapy equipment (1–3 years) had the largest influence on estimated costs, which increased more than ten-fold when all parameters were set to the alternative high-cost assumptions (see Technical Appendix).

National resource requirements

Based on modelled per woman costs (base case scenario), it is estimated that approximately 7.9 million GHS (5.3 million US$) are required for scale-up to a national cervical cancer screening programme (investment costs) under base case assumptions of 70% coverage, screening every five years, and 2.63% of screened women treated with cryotherapy (see Table 1). Annual costs for running a national programme (including annuitized costs of capital) are estimated to be 4.1 million GHS (2.7 million US$). However, large differences were found depending on the chosen screening strategy (every five years vs. once a lifetime, see Table 1) and assumed cost scenarios (see Technical Appendix).

Discussion

Results from surveyed facilities showed high variability of VIA and cryotherapy costs in Ghana. The

Figure 1.VIA screening costs per woman (2009 GHS)

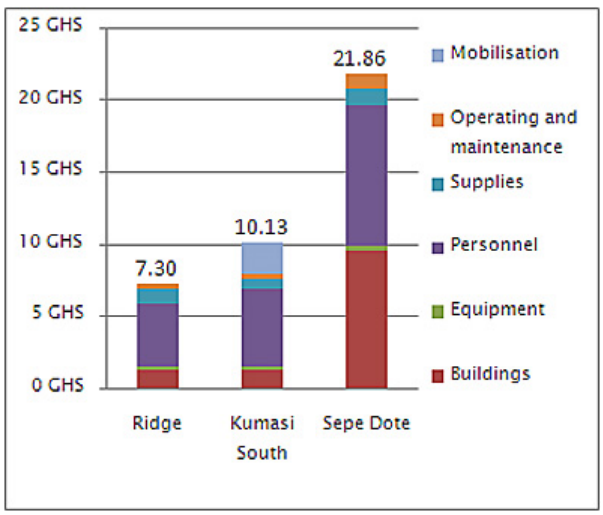
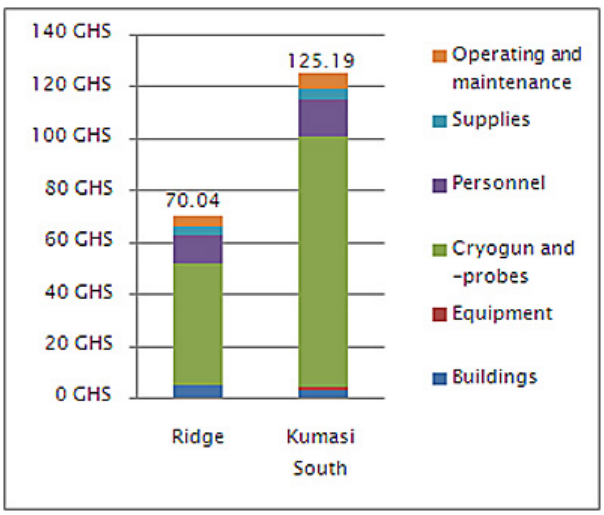


Figure 2. Cryotherapy costs per woman (2009 GHS)



Screening strategy	Every five years		Once a life-time	
	100% coverage	70% coverage	100% coverage	70% coverage
Cost components	**National scale-up costs (GHS)**		**National scale-up costs (GHS)**	
Training costs	944,153	660,907	189,033	132,323
Cryotherapy equipment	754,001	527,800	150,962	105,673
Increasing facility capacity	9,516,574	6,661,602	1,905,359	1,333,752
Total	11,214,728	7,850,309	2,245,355	1,571,748
	National programme costs (GHS)		**National programme costs (GHS)**	
VIA	5,171,413	3,619,989	1,035,394	724,776
Cryotherapy (2.63%)	630,583	441,408	126,252	88,377
Total	5,801,997	4,061,398	1,161,646	813,152

Table 1. Estimated VIA/cryotherapy costs for scale-up (investment costs) and annual costs for running a national programme (based on Ghana female population 2009, see Technical Appendix for details)

cost figures lie closer to those reported for South Africa (8.15 and 10.63 US$) than to costs estimated for Kenya (1.31 US$) [3;4], and were also above those reported for Thailand (1.14 US$) and India (4.68 U$) [5;6].[ii] The most important determinants of costs obtained through modelling were related to volume, such as number of women screened per nurse or treated per cryotherapy machine. Previous cost-effectiveness studies have ignored volume effects suggestive of economies of scale. Consequently, derived recommendations concerning the most cost-effective screening strategies may need to be reconsidered. If a national VIA and cryotherapy programme had been in place in Ghana in 2009, the estimations show that under base-case cost assumptions, the programme's total costs would have consumed less than 1% of total health expenditures in Ghana (based on data from 2008 [7]). However, national estimates are very sensitive to changes to the assumptions.

Recommendations

- **Policymakers** should pay attention to the most important determinants of costs of VIA and cryotherapy identified in this study (i.e. number of women screened per provider and treated per facility), considering the implications of potential economies of scale. VIA and cryotherapy are only part of a more holistic cervical cancer prevention strategy that should aim to include HPV vaccines and possibly new HPV detection tests once their performance and cost-effectiveness in resource-constrained settings have been evaluated.
- **Researchers** should focus their attention on the specific determinants of costs of VIA and cryotherapy before embarking on future cost-effectiveness studies of alternative cervical cancer prevention strategies.

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Acknowledgements

We thank all persons and institutions who contributed to this study from Kumasi South Hospital, Sepe Dote Clinic, and Komfo Anokye Teaching Hospital and Medilab in Kumasi; Ridge Hospital, Tema Hospital, Korle Bu Teaching Hospital Pathology and Radiotherapy departments, Allied Health Services, and Ninalyn Gyne Cytology in Accra; staff from the Ghana Health Services Disease Control Unit and EPI program; and staff from the University of Utah and JHPIEGO.

The study was supported by grants from the London School of Hygiene and Tropical Medicine Trust Fund and the UK Department for International Development (DFID) funded Research Programme Consortium for Research and Capacity Building in Sexual and Reproductive Health and HIV in Developing Countries. The views and opinions expressed are those of the authors alone.

[ii] Published results were converted to year 2009 US$ using IMF (2009) [8] GDP deflators and PPP conversion rates.

Technical Appendix

Costing model

The costing model made assumptions for costs of inputs, effective working time of capital and staff, costs of training, and duration of screening/ management per woman (see Table 2 for details).

Alternative costing scenarios

For the multivariate sensitivity analysis, all input parameters were simultaneously set to the low cost assumptions or high cost assumptions, respectively, in order to generate the largest possible range of costs in an analysis of extremes (see Table 3 for results).

Population assumptions

Total national costs were calculated by multiplying estimated per woman costs with the number of women assumed to require screening and cryotherapy per year (see Table 4 for details).

Table 3. Estimated incremental economic costs per woman for different scenarios (2009 GHS)

	High cost (all values at maximum)	Base case	Low cost (all values at minimum)
VIA	21.9	8.91	5.75
Cryotherapy	469.73	41.31	21.90

Table 2. Input parameters for costing model

	High cost	Base case	Low cost
Capital - buildings (size 16m²)			
Costs per m² (GHS)	4000	2000	1650
% effective working time	40%	60%	80%
Capital - equipment			
VIA/cryotherapy		international equipment	locally manufac-tured equipment
Cryotherapy			
Working life of cryogun (yrs)	1	2	3
No. of patients per year	5.4	45	60
Capital - Discount rate	5%	3%	0%
Time requirements			
VIA (min)	45	17	15
Cryotherapy (min)	60	50	45
Recurrent - Staff			
Category of personnel	Principal nurse	Senior nurse	Junior nurse
Nurse salary (GHS)	1112	577	350
Assistant salary (GHS)		120	
No. of VIA per nurse per year	1000	600	200
% effective working time	40%	60%	80%
Recurrent supplies			
VIA	With gas for boiling of instruments	Without gas for boiling of instruments	
Cryotherapy			
Recurrent - mobilisation/ recruitment			
Costs per patient as found at Kumasi South hospital			

Table 4. Estimated number of women requiring VIA/cryotherapy in the year 2009 by adopted screening strategy and assumed VIA positivity rate

Screening strategy	Screen every five years Women 25–45 years[1]	Screen once per lifetime Women 35–45 years[2]
VIA 100% coverage[3]	580,406	116,206
VIA 70% coverage	406,284	81,344
Cryotherapies 100% coverage (2.63% of screened)[4]	15,265	3,056
Cryotherapies 70% coverage (2.63% of screened)	10,685	2,139
Cryotherapies 100% coverage (10% of screened)[5]	58,041	11,621
Cryotherapies 70% coverage (10% of screened)	40,628	8,134

[1] Current practice in Ghana.
[2] WHO (2002) recommendations for low-income countries introducing cervical cancer screening [2].
[3] Based on reported female population by age group in WHO/ICO (2007) [9], extrapolated to the year 2009 assuming an average population growth rate of 2.0% [10].
[4] 2.63% was the proportion of VIA positive women out of all screens between January 2008 and July 2009.
[5] According to Sankaranarayanan & Wesley (2003), skilled providers identify 8-15% of screened women as positive [11]. In Blumenthal et al. (2007) test-positivity rate was 13.2% [12]; in Legood et al. (2005) it was 10% [6].

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This brief is an output from a programme funded by the UK Department for International Development (DFID). The views expressed are not necessarily those of DFID.

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