

The cost-effectiveness of introducing manual vacuum aspiration compared with dilatation and curettage for incomplete first-trimester miscarriages at a tertiary hospital in Manzini, Swaziland

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Background. Despite the proven efficacy of manual vacuum aspiration (MVA) for incomplete miscarriages its use is low in Swaziland, including Raleigh Fitkin Memorial (RFM) Hospital, Manzini. Uncertainty about the cost implications of introducing MVA to replace dilatation and curettage (D&C) is probably the major obstacle to change.

Objectives. To evaluate the cost-effectiveness of introducing MVA as an evacuation method for first-trimester incomplete miscarriages, as well as assess the implications of the introduction of MVA for the entire post-miscarriage care budget at RFM Hospital.

Methods. The methods comprised cost-effectiveness and budget-impact analyses from a healthcare perspective based on a theoretical cohort. Clinical outcomes data for procedures were obtained from the relevant literature. Costs were collated from prospective suppliers and then compared for the two treatment modalities. Future numbers of annual evacuations were extrapolated from previous annual figures. First-trimester miscarriages were in turn extrapolated from proportions found in previous studies. Total budgets were calculated under the current scenario, and for scenarios where MVA was introduced.

Results. With initial capital costs of ZAR11 093.00, introduction of MVA for first-trimester incomplete abortions would cut post-miscarriage care costs by 34.7%. MVA would cost ZAR819.86 per procedure, while D&C costs ZAR1 255.40 per procedure. An estimated 26 MVA procedures done instead of D&Cs would compensate for the initial capital investment. Introduction of MVA into the post-miscarriage care programme would save the hospital about ZAR516 115.30 annually, with clinical outcomes at least similar to D&C.

Conclusions. MVA should be considered as the first option in first-trimester post-miscarriage care.

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Pre-viability pregnancy loss may be associated with many complications, both physical and emotional. With miscarriage contributing as much as 13% to maternal mortality,^[1] it is imperative that every healthcare system employs the most effective management protocols, especially for complications of miscarriages. Effective and expedient treatment services, family planning (FP) services provision, and functional linkages between treatment services and the rest of reproductive healthcare are essential elements of any successful miscarriage management programme,^[2] and could reduce mortality rates by up to one-fifth.^[3]

The decision about which definitive management protocols a particular setting should adopt is usually based on resource and infrastructure availability, technical and practice limitations of personnel involved, patient preferences and, to a larger extent, clinical efficacy of a particular method.^[4] While well-developed settings may choose less invasive methods as their first option, as they can monitor their patients closely, resource-limited settings tend to prefer more definitive methods because it is difficult to institute close monitoring of patients for possible complications and incomplete evacuations.

Expectant management involves waiting for natural expulsion of retained products of conception. Although this method has low

infection rates, its use is limited by the low success rate (sometimes as low as 39%).^[5] Medical management is another non-invasive option, but with success rates sometimes as low as 62% this approach faces the same limitations as expectant management in settings where access to healthcare may be limited.^[5] With conservative approaches only marginally superior in terms of infection risk,^[6] the choice in most settings is based on success rates. In addition, expectant and medically managed patients have an increased risk of unplanned admissions and repeat evacuations when compared with those managed surgically.^[7]

Surgical evacuation can be done through one of two methods, dilatation and curettage (D&C) and manual vacuum aspiration (MVA). Studies have demonstrated that D&C is associated with longer care times for patients, including pre-definitive management,^[8] and generally has to be done in theatre. As a result there has been a shift towards MVA, which is not only less traumatic but outweighs D&C in a few other clinical attributes. However, there has been a delay in the shift in some settings, even in resource-limited settings that stand to gain a lot from sustainable surgical termination of pregnancy and emergency post-miscarriage care.^[9] In addition, all-complications rates are lower and client satisfaction is improved following MVA compared with D&C.^[10] Furthermore, MVA is a simpler procedure that can even be done by midwives without compromising clinical

outcomes.^[11] MVA use is associated with significant reductions in morbidity, blood loss, hospital stay, loss of productivity and, importantly, costs to the health service.^[8,10,12-15]

Considering the above evidence and the situation in Swaziland, this study aimed to: (i) assess the cost-effectiveness of introducing MVA in place of D&C in the management of first-trimester incomplete miscarriages at Raleigh Fitkin Memorial (RFM) Hospital, a central hospital in Manzini, Swaziland; and (ii) evaluate the possible budget implications of the same change to the post-miscarriage care programme.

Methods

Economic evaluations (cost-effectiveness and budget-impact analyses) from a health service perspective based on a theoretical cohort and mixed data sources were done at RFM Hospital, a 350-bed multidisciplinary facility with an average of 20 - 25 deliveries a day and up to 60 daily consultations in the gynaecological outpatients unit alone. About 25 incomplete miscarriages are managed weekly, all by D&C in the main theatre.

All evacuations for first-trimester incomplete miscarriages were included. Evacuations for other reasons were excluded. Future numbers were extrapolated based on previous trends for the budget impact analysis.

Approval for the study was obtained from the Main Ethics Committee of the Faculty of Health Sciences, University of Pretoria, the Scientific and Research Ethics Committee of Swaziland, and the RFM Hospital administration.

The model

The two alternatives to the active management of incomplete abortions are illustrated in Fig. 1, the D&C arm being the one currently in use.

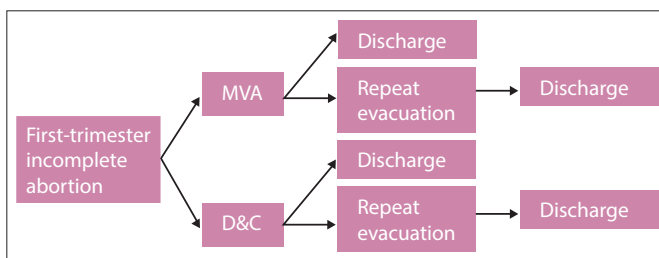


Fig. 1. Treatment modalities compared in the study (MVA = manual vacuum aspiration; D&C = dilatation and curettage).

Measurements

Efficacy data

Efficacy data were inferred from relevant studies comparing MVA with D&C and are shown in Table 1, with the sensitivity analysis ranges where appropriate.

Costing

A cost sheet was designed for each procedure. Costs, as obtained from various sources, were entered into an Excel-based spreadsheet and were as follows:

- **Capital costs.** These were for MVA, which is not being done at the moment, and included staff training and purchase of an extra gynaecological bed and speculums.
- **Human resources costs.** A working month comprised 4 weeks, with each week comprising 40 hours. Hourly rates were calculated as monthly salary divided by 160. The personnel components of procedure costs were the times the respective healthcare workers would be caring for the patient.
- **Other direct medical costs.** These included detergents, anaesthesia and analgesia, antibiotics, procedure kits, FP consultation and admission (based on Swaziland-specific costs of the hotel (hospital stay) component of admission as per WHO-CHOICE 2005.^[12] The hotel component as estimated by the World Health Organization excludes drugs, procedures and diagnostics but includes costs of consultations, meals, nursing and other personnel time outside procedure periods.
- **Indirect medical/overhead costs.** The annual hospital operating expenditure for 2011, including utility bills, waste disposal, professional services, toilet and cleaning supplies, computer services, and transport and vehicle maintenance, was divided by the total number of attendances per year at the hospital, with an assumption of uniformity in cost distribution.
- **Discounting.** No discounting was done for costs, as these were comparisons in the same calendar year.

Budget-impact analysis

By extrapolation, the total number of possible MVA procedures was calculated and the total budget for first-trimester post-miscarriage care deduced from individual patient costs. In addition to other variations in the sensitivity analysis, the possibility of having MVA done by trained midwives was explored as well.

Table 1. Clinical outcomes data

Outcome measure	MVA outcome	D&C outcome	Source
Success rate, %	100	99.3	Verkuyl and Crowther ^[14]
All complications, % (95% CI)	1.2 (1 - 1.4)	5 (4 - 10)	Warriner <i>et al.</i> ^[11] (MVA); Zhou <i>et al.</i> ^[16] (D&C)
Pre-op time (min), mean			Mexico Population Council ^[8]
Nurse	92.8	63.8	
Medical officer	88.1	75.1	
Pelvic infection, % (95% CI)	1 (0.2 - 5.4)	4 (0.7 - 6)	Mahomed <i>et al.</i> ^[6]
Excessive blood loss, % (95% CI)	0 (0 - 15.7)	0.1 (0 - 28)	Verkuyl and Crowther ^[14]
Admission, %	0	100	Mexico Population Council ^[8]
Proportion FP-counselled, % (95% CI)	85.5 (68.5 - 100)	42.4 (33.9 - 50.9)	Mexico Population Council ^[8]

MVA = manual vacuum aspiration; D&C = dilatation and curettage; CI = confidence interval; FP = family planning.

Results

Miscarriages accounted for over 57% of gynaecological admissions at RFM Hospital during the periods reviewed. Table 2 shows the number of evacuations for the years 2009 - 2011. An increase of 8.12% in number of evacuations is proposed, being the average of the increases over the preceding years, giving an estimated 1 395 evacuations for the year 2012. This translates to 1 185 first-trimester evacuations.

A total of ZAR11 092.73 is required to introduce MVA (Table 3). Afterwards, an MVA procedure costs about ZAR819.86, 34.7% less than D&C, which costs ZAR1 255.40 per procedure (Table 4). Approximately 26 MVA procedures done instead of D&C will result in a saving equivalent to the initial capital costs.

Significant reductions would be noted in human resources costs (28%) and procedure consumables and medical supplies (41%) if MVA were to be done instead of D&C (Table 4). An additional FP visit is required with D&C but not with MVA, since the latter is a 'day procedure'.

The total budget for first-trimester post-miscarriage care using D&C was about ZAR1 487 649.00 per year. It would cost ZAR971 533.70 per annum using MVA for first-trimester miscarriages, a reduction of 34.7% (ZAR516 115.30).

Sensitivity analysis

Univariate sensitivity analysis was done for the major components of procedure costs for both treatment methods (Tables 4 and 5). An arbitrary 20% variation on most costs was chosen, as it was considered enough to cater for any realistic variation that may be encountered in practice. MVA was confirmed to be robustly cost-effective and remained dominant over D&C in all extremes of univariate sensitivity analysis. As a result, no incremental cost-effectiveness ratios are reported.

The biggest influences on costs in the sensitivity analysis were personnel costs, particularly medical officers' and nurses' time. MVA maintained dominance in all ranges of sensitivity analysis.

D&C remained costly compared with MVA even with variation of 'bulk' items such as direct medical costs and human resources costs (Tables 6 and 7).

If all MVAs were to be done by midwives, there would be a 54.2% reduction in first-trimester post-miscarriage care costs, saving the hospital ZAR806 381.00 annually. The rest of the individual component costs were not as influential in the univariate analysis, as reflected in Tables 6 and 7.

Discussion

The results indicate that introduction of MVA would be a very cost-effective change to the post-miscarriage care programme at RFM Hospital. Significant cuts in costs to the hospital, and possibly to patients as well, are likely to be realised, especially as a result of shorter hospital stays and reduced morbidity resulting from MVA in comparison with D&C. Such significant sums saved through the introduction of MVA may in fact be enough to fund parallel programmes or other components of reproductive health such as prevention of unsafe abortion, safe pregnancy termination awareness promotion, and advocacy for the improvement of the entire sexual and reproductive health service. In addition, the fact that all MVA procedures (~85% of post-miscarriage evacuations) can be done by middle-level health workers such as midwives^[11] will improve the emergency component of post-miscarriage care.

Table 2. Numbers of evacuations for the 3 years starting 2009

Year	All evacuations of products of conception, n	% change
2009	911	-
2010	1 015	+11.42
2011	1 065	+4.93

Table 3. Capital costs of setting up MVA services

Item	Cost (ZAR)	Comments
Training	6 000	Quotes from Swazipharm for capital items, training costs obtained from Médecins Sans Frontières workshop costs
Gynaecological bed	4 278.73	
Speculums	814.27	
Total capital costs	11 092.73	

Table 4. Major costs for both treatment modalities

Item	Cost (ZAR)		Source/comments
	MVA	D&C	
Direct medical costs			Admission and outpatients consultation costs obtained from WHO-CHOICE 2008 ^[12]
Admission	-	191.47	
OPD consultation	72.54	72.54	
Family planning visit	-	72.54	Central Medical Stores and Swazipharm for other direct medical costs
Procedure consumables	401.17	682.97	
Human resources			Basic salaries were obtained from the hospital Personnel Department and pro-rated with time spent with patient
Medical officer	244.95	312.26	
Nurse	117.67	185.26	
Anaesthetist	-	15.65	Times were inferred from the Mexico Population Council study ^[8]
Others	22.38	25.70	
Indirect medical costs	33.57	33.57	Calculated from annual hospital operating expenditure excluding direct medical expenditure divided by the total number of attendances in the year
Grand totals	819.86	1 255.40	

Table 5. Major contributions to procedure costs

Item	Contribution (%)	
	MVA	D&C
Medical officer	29.8	24.9
Nurse	14.4	14.8
Procedure consumables	50.0	54.4
Admission	-	15.3
OPD consultation	8.8	5.8
Family planning consultation	-	5.8

MVA = manual vacuum aspiration; D&C = dilatation and curettage; OPD = outpatient department.

The study results have shown some consistency with those from other settings such as Peru, Mexico and Kenya, in that MVA is associated with significant reductions in post-miscarriage care costs.

Table 6. Univariate sensitivity analysis results for MVA

Cost parameter	Total cost (ZAR)		Comments
	Upper limit	Lower limit	
Medical officer	868.85	574.91	Lower limit was 'no medical officer', upper limit was 20% more on medical officer
Nurse	843.39	796.33	±20% as limits
Other direct medical costs (combined)	900.70	740.03	±20% as limits

MVA = manual vacuum aspiration.

Table 7. Univariate sensitivity analysis results for D&C

Cost parameter	Total cost (ZAR)		Comments
	Upper limit	Lower limit	
Medical officer	1 317.85	1 192.95	20% variation
Nurse	1 292.45	1 218.35	20% variation
Other direct medical costs (combined)	1 391.99	1 118.81	20% variation
Total human resources costs	1 363.17	1 147.63	20% variation

D&C = dilatation and curettage.

The cost of MVA found in our study is similar to that in a study conducted in Peru (US\$118.73, equivalent to about ZAR950).^[13] In a 1996 Mexican study, D&C was found to cost US\$264 (about ZAR2 000) per procedure, while MVA cost US\$74 (about ZAR600) per procedure.^[8] In a Kenyan study, D&C was estimated at US\$17 (about ZAR136) per procedure, US\$11 more than the cost of MVA.^[15] These results are somewhat different from ours, probably as a result of differences in methodology, setting and, perhaps more importantly, time and associated economic changes. The 28% and 41% decreases in staff and supplies, respectively, tally with reductions found in the Mexican study for the same cost components (33% for staff and 65% for instruments and supplies).

The somewhat smaller overall reduction with MVA introduction noted in the current study compared with the others could be explained by the differences in settings alone. However, the fact that the current study was a desk analysis while the others were prospective studies could have had an effect. In addition, the use of mixed data sources may have brought in heterogeneity to the analysis. Furthermore, the analyses from other studies were carried out a number of years earlier than those in the current study, which could have influenced the cost differences.

Owing to similarities in suppliers and the way procedures are done, the results of this study are generalisable to the whole of Swaziland, including private facilities. The same consideration makes the findings transferable to the rest of the region, including South Africa and the rest of sub-Saharan Africa, and especially the Southern African Development Community region, as these have similar and

functionally linked healthcare and economic structures. The low set-up costs and the invaluable opportunity to free up main theatres should make the introduction of MVA easy and sustainable.

Limitations

As this was not a prospective study, the actual times that these procedures take at RFM Hospital were not recorded. In addition, it was difficult to assign care times for other personnel such as porters and arbitrary times had to be assigned, which may differ from reality. However, these times are relatively small and may offset each other in the two arms of the comparison, resulting in minimal bias. Other small costs that may have been omitted include transfusions, information on which was not easily accessible, as most studies evaluated had no power to evaluate such 'rare' events.

A further limitation to the study was the fact that it used one perspective only. More information on savings could have been obtained if the healthcare user's perspective had been included, as it would have included information on loss of productivity due to post-abort and post-procedure morbidity.

Conclusion

MVA, being at least as safe and efficacious as D&C, is a cost-effective replacement for D&C for first-trimester miscarriage at RFM Hospital and will save much-needed money. We recommend that MVA be considered the first management option for first-trimester incomplete miscarriages.

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