Point-of-care HIV viral load in pregnant women without prenatal care: a cost-effectiveness analysis

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BACKGROUND: Routine cesarean delivery has been shown to decrease mother-to-child-transmission of HIV in women with high viral load greater than 1000 copies/mL; however, women presenting late in pregnancy may not have viral load results before delivery.

OBJECTIVE: Our study investigated the costs and outcomes of using a point-of-care HIV RNA viral load test to guide delivery compared with routine cesarean delivery for all in the setting of unknown viral load.

STUDY DESIGN: A decision-analytic model was constructed using TreeAge software to compare HIV RNA viral load testing vs routine cesarean delivery for all in a theoretical cohort of 1275 HIV-positive women without prenatal care who presented at term for delivery, the estimated population of HIV-positive women without prenatal care in the United States annually. TreeAge Pro software is used to build decision trees modeling clinical problems and perform cost-effectiveness, sensitivity, and simulation analysis to identify the optimal outcome. The average cost per test was $15.22. To examine the downstream impact of a cesarean delivery and because most childbearing women in the United States will deliver 2 children, we incorporated a second pregnancy and delivery in the model. Primary outcomes were mother-to-child transmission, delivery mode, cesarean delivery—related complications, cost, and quality-adjusted life years. Model inputs were derived from the literature and varied in sensitivity analyses. The cost-effectiveness threshold was $100,000/quality-adjusted life year.

RESULTS: Measuring viral load resulted in more HIV-infected neonates than routine cesarean delivery for all due to viral exposure during more frequent vaginal births in this strategy. There were no observed maternal deaths or differences in cesarean delivery—related complications. Quantifying viral load increased cost by $3,883,371 and decreased quality-adjusted life years by 63 compared with routine cesarean delivery for all. With the threshold set at $100,000/quality-adjusted life year, the viral load test is cost-effective only when the vertical transmission rate in women with high viral load was below 0.68% (baseline: 16.8%) and when the odds ratio of vertical transmission with routine cesarean delivery for all compared with vaginal delivery was above 0.885 (baseline: 0.3).

CONCLUSIONS: For HIV-infected pregnant women without prenatal care, quantifying viral load to guide mode of delivery using a point-of-care test resulted in increased costs and decreased effectiveness when compared with routine cesarean delivery for all, even after including downstream complications of cesarean delivery.

Key words: biomarker, cesarean, HIV testing, mother-to-child-transmission, point-of-care test, pregnancy outcomes, rapid test, vertical transmission, viral load

Human immunodeficiency virus (HIV) suppression at delivery is essential for preventing mother-to-child transmission (MTCT).[1–3] Public health recommendations advocating for first-trimester HIV screening and highly active antiretroviral therapy (HAART) have made this achievement possible.[4] However, HIV-infected women without prenatal care who present late in pregnancy are unlikely to have achieved low viral load (VL) compared with those with adequate prenatal care.[5,6] Women with a high VL (>1000 copies/mL) at delivery are at greater risk for MTCT compared with women with low VL (<1000 copies/mL).[1,2,4] In women with HIV, routine cesarean delivery has been shown to decrease the rate of vertical transmission compared with vaginal delivery, even after controlling for receipt of antiretroviral therapy.[7,8] These data have shaped current guidelines to recommend routine cesarean delivery at term in women with high (>1000 copies/mL) or unknown VL.[9]

HIV-infected women who present late in pregnancy may not have VL information available before delivery, as these tests are usually processed at outside laboratories and results may take several days depending on location.[10,11] The Xpert HIV-1 Viral Load test (Cepheid, Sunnyvale, CA) is a novel automated reverse transcriptase polymerase chain reaction assay that can quantify HIV-1 RNA in human plasma samples between the range of 40 to 10^7 copies/mL in 90 minutes.[12] In 2017, this test was approved by the World Health Organization for use in resource-limited areas and has been subsequently validated in several clinical settings.[13–16] Using VL to allocate mode of delivery in women with unknown HIV RNA levels may decrease unnecessary cesarean deliveries, thereby impacting immediate surgical risks as well as downstream cesarean delivery—related complications in future pregnancies. Given these concerns, our purpose was to investigate the costs and outcomes across 2 deliveries of using a point-of-care HIV RNA VL test to guide mode of delivery compared with routine cesarean delivery for all HIV-infected pregnant women without prenatal care in the setting of unknown VL.

Materials and Methods

A decision-analytic model was constructed using TreeAge Pro software (2018; TreeAge Software, Inc, Williamstown, MA) to compare Xpert HIV-1 RNA VL test vs routine cesarean delivery for all in HIV-infected women without prenatal care and unknown VL who presented at term for delivery

Cite this article as: Avram CM, Greiner KS, Tilden E, et al. Point-of-care HIV viral load in pregnant women without prenatal care: a cost-effectiveness analysis. Am J Obstet Gynecol 2019;221:265.e1-9.

0002-9378/$36.00

https://doi.org/10.1016/j.ajog.2019.06.021

AJOG at a Glance

Why was the study conducted?

Current guidelines recommend routine cesarean delivery in HIV-infected pregnant women with high or unknown viral load. Using a point-of-care HIV RNA quantification test in HIV-infected pregnant women without prenatal care may reduce unnecessary cesarean deliveries, thereby mitigating immediate surgical risks and downstream complications in future pregnancies.

Key findings

For HIV-infected pregnant women without prenatal care, quantifying viral load to guide mode of delivery using a point-of-care HIV RNA quantification test resulted in more neonatal HIV infections and fewer cesarean deliveries but no difference in cesarean-related complications. This strategy was not cost-effective when compared with routine cesarean delivery for all.

What does this add to what is known?

Cesarean delivery prevention in this population requires access to adequate and timely prenatal care so that viral load quantification and suppression can be accomplished before delivery.

(Figure 1). The initial decision stratified women into 2 pathways: (1) point-of-care HIV RNA VL test, or (2) routine cesarean delivery. Of those who received HIV RNA quantification, women who were found to have high VL underwent cesarean delivery and women with low VL were allowed to deliver vaginally and, if unsuccessful, proceeded to cesarean delivery. We evaluated neonatal HIV infection, mode of delivery, cesarean delivery–related complications, and maternal mortality over the course of 2 deliveries.

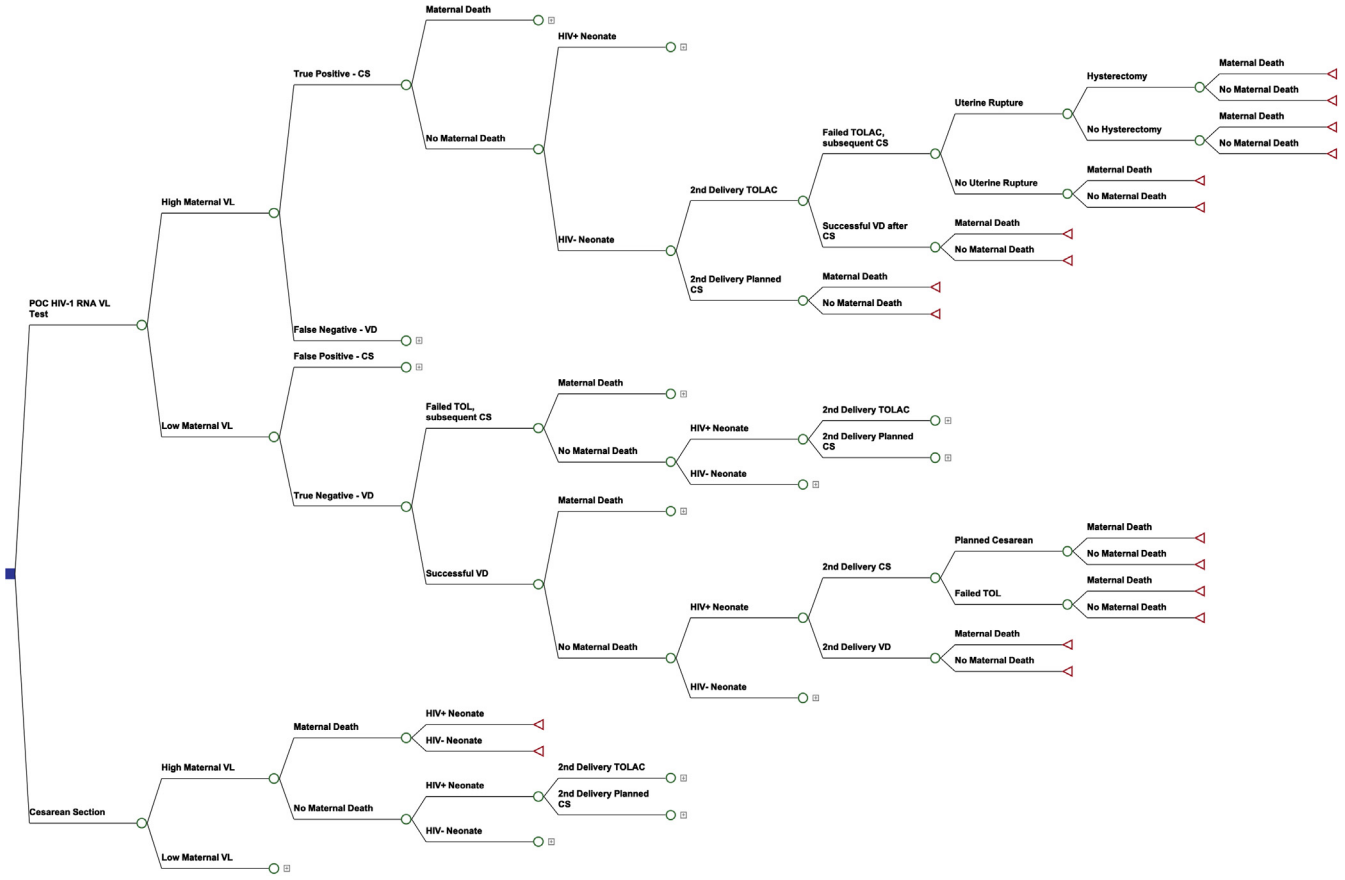
Our theoretical cohort was composed of 1275 women, the estimated population of women who are HIV-positive and who have not received prenatal care in the United States annually.[17,18] All women in our cohort were assumed to have uncomplicated pregnancies (term, singleton, vertex fetuses) who presented at greater than or equal to 37 weeks. The model assumed that women presented before the rupture of membranes with time to receive intrapartum antiretroviral therapy before delivery. We incorporated the possibility of a next pregnancy and delivery for all women who survived the index pregnancy. We assumed that women had access to prenatal care in the second pregnancy and proceeded to a second delivery with undetectable VL, regardless of VL in the first delivery. Qualitative studies show that women with HIV demonstrate high motivation to adhere to HAART during the antepartum period to decrease MTCT.[5,19] As such, women with known HIV status before their second pregnancy are more likely to engage with prenatal care, receive HAART, and achieve viral suppression before delivery. We used 2 deliveries per woman to reflect the average number of births per US woman.[20] This theoretical model did not involve human subjects; thereby, it was exempt from institutional review board approval.

The baseline probability inputs were obtained from the literature (Table 1).[1,2,7,16,21–26] In a prequalification study by the World Health Organization, the sensitivity and specificity of the Xpert HIV-1 Viral Load assay at a cut-off of 1000 copies/mL were 94.14% and 98.50%, respectively.[16] The proportion of women who present with high VL at delivery and the rate of MTCT in this subset were derived from the Women and Infants Transmission Study, a multicenter prospective study of perinatal HIV infection.[1] The rate of MTCT associated with low VL was obtained from a registry of mother–infant dyads in the United States and Europe; these data included a larger sample of women with low VL compared with the Women and Infants Transmission Study cohort.[2] The probability of actual vaginal delivery in those initially allocated to this mode of delivery and the odds ratio (OR) of perinatal HIV infection associated with routine cesarean delivery were derived from a randomized controlled trial comparing routine cesarean delivery vs vaginal delivery in vertical HIV-1 transmission.[7] The OR of transmission with vaginal delivery and emergent cesarean delivery was 1. Using these data, we calculated the probability of neonatal HIV infection by considering transmission rates due to maternal VL and mode of delivery (Table 1).

Cost inputs were obtained from the literature and were inflated to 2019 US dollars using the medical component of the Consumer Price Index (Table 2).[12,27–34] The costs assumed a societal perspective and, when applicable, were applied over a lifetime. The cost per test of the Xpert HIV-1 Viral Load assay was calculated by equally distributing the costs of the processing platform and consumables.[12] To calculate lifetime cost of neonatal HIV infection in the HAART era, we used a discount rate of 3% to amortize the average annual medical expenditure for an HIV-infected patient, as determined by a cross-sectional multicenter study, over an estimated lifespan of 50 years for persons with neonatal HIV infection who are compliant with HAART.[27,30]

The costs for a cesarean and vaginal delivery, labor time, uterine rupture including repair, and hysterectomy were estimated from a cost-effectiveness analysis of trial of labor after cesarean (TOLAC).[28] The baseline cost of vaginal and cesarean delivery, without labor time, includes antepartum care, labor and delivery with or without surgery, and postpartum care. Based on a study quantifying duration of active labor in low-risk women, we found that active labor in nulliparous deliveries was 1.43 times longer compared with multiparous deliveries.[35] Assuming an equal distribution of deliveries, we calculated the cost of the additional hours of labor to differentiate the total cost of labor time resulting in a vaginal delivery for nulliparous and multiparous women. We similarly estimated incremental

FIGURE 1
Cost-effectiveness model



[+] indicates collapsed branches that lead to identical branches as the ones that are displayed.

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hours of labor unit costs for women undergoing TOLAC.

In addition to medical expenditures, the cost of maternal death also included the opportunity cost of lost earnings based on median weekly income for a woman with full-time salary or wage according to the Bureau of Labor Statistics.[36] We assumed that the age at first birth was 26.6 years, with 2.4 years in between the first and second pregnancy. Given that the average age at retirement is 62 years of age, we approximated the amount of lost productivity after each delivery.[37]

We incorporated both maternal and neonatal quality-adjusted life years (QALYs) into our analysis (Table 2). We combined maternal and neonatal QALYs to assess the cost-effectiveness of our interventions from the combined maternal–neonatal perspective that would balance the impact on both individuals. This is important to account for a possible increase in neonatal QALYs that could outweigh maternal QALYs, and vice versa.[38,39] QALYs were calculated by applying utilities—quality-of-life preferences—to life expectancies and were discounted annually by 3%. Assuming compliance with HAART, the highest possible neonatal utilities for HIV infection without progression to acquired immunodeficiency syndrome were 0.95 for age <45 years and 0.92 for the remaining 5 years of life, assuming a maximum life expectancy of 50 years.[30] The parental utility for neonatal HIV infection was not available in the literature. Based on similarity of chronic health state, we assumed the maternal utility was comparable with having an offspring with moderate persistent asthma at 0.88.[31] This value is proportionate to community-derived perspectives regarding HIV infection.[32] The utilities for cesarean delivery and vaginal delivery were 0.996 and 1, respectively.[29] We used a utility of 0.963 for hysterectomy and applied it for the duration of remaining maternal fertility of 20 years, assuming average age of menopause is 49.[28]

Clinical outcomes for the first and second deliveries were calculated for both pathways in our model: HIV RNA VL to guide mode of delivery vs routine cesarean delivery for all. First delivery outcomes included neonatal HIV infection, mode of delivery, and maternal death. Second delivery

TABLE 1
Probabilities used in the model

Variable	Value	Range considered in sensitivity analysis	References
High VL at delivery	0.865	0–1	1
Sensitivity at 1000 copies/mL	0.9414	0.85–1.0	16
Specificity at 1000 copies/mL	0.985	0.85–1.0	16
Vertical transmission, low maternal VL (ART during pregnancy or at delivery)	0.01	0.001–0.2	2
Vertical transmission, high maternal VL (ART during pregnancy or at delivery)	0.168	0.001–0.4	1
Odds ratio of transmission via CD	0.3	0–1	7
Neonatal HIV infection (high VL, CD)	[a]	—	See text
Neonatal HIV infection (high VL, VD or unplanned CD)	[b]	—	1
Neonatal HIV infection (low VL, CD)	[c]	—	See text
Neonatal HIV infection (low VL, VD, or unplanned CD)	[d]	—	2
Successful VD	0.732	0.5–1.0	7
Maternal death (first delivery)			
After VD	0.00001695	0.00001–0.0001	21, 22
After CD	0.0001628	0.0001–0.0005	21, 22
Subsequent pregnancy			
Routine CD after previous VD	0.0065	0.001–0.01	23
CD after previous VD (planned and failed TOL)	0.0309	0.01–0.1	23
TOLAC	0.58	0.3–0.7	24
CD after failed TOLAC	0.28	0.2–0.5	24
Uterine rupture	0.00468	0.001–0.05	24
Hysterectomy after uterine rupture	0.2632	0.1–0.4	22
Maternal death (second delivery)			
After planned repeat CD	0.000443	0.0001–0.001	22
After TOLAC	0.0001676	0.0001–0.0005	22
After uterine rupture	0.001136	0.001–0.005	25
After hysterectomy	0.0194	0.01–0.05	26
Discount rate	0.03	0–0.05	See text

ART, antiretroviral therapy; *CD*, cesarean delivery; *TOL*, trial of labor; *TOLAC*, trial of labor after cesarean; *VD*, vaginal delivery; *VL*, viral load.

[a] Odds ratio of CD multiplied by the probability of perinatal transmission if high maternal VL; [b] Assumed to be the same as vertical transmission, high maternal VL; [c] Odds ratio of CD multiplied by the probability of vertical transmission if low maternal VL; [d] Assumed to be the same as vertical transmission, low maternal VL.

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outcomes included mode of delivery (vaginal birth and cesarean delivery), uterine rupture after failed TOLAC, hysterectomy following uterine rupture, and maternal death. We also evaluated overall cost and QALYs to determine the incremental cost-effectiveness ratio of using a point-of-care HIV VL quantification test to inform mode of delivery in HIV-infected pregnant women without prenatal care. An incremental cost-effectiveness ratio of $100,000/QALY or less was considered to be cost-effective. Our analysis was conducted from a societal perspective.

Univariate sensitivity analyses were performed on probabilities, costs, and utilities to evaluate the robustness of our results. We created a tornado diagram to assess which model inputs had the greatest impact on outcomes. These variables were further evaluated in a threshold analysis to determine the value over which the outcome remained cost-effective. We simulated 10,000 trials in a Monte Carlo analysis to evaluate multivariable changes in probabilities and costs. Probabilities were assessed with a beta distribution to approximate the normal distribution. A gamma distribution was used to assess costs, with the right skew accounting for outliers in upper-bound range of medical costs. In cases in which standard deviations of probabilities were not available in the literature, we conservatively estimated wide ranges to consider the minimum and maximum extremes.

Results

In our theoretical cohort of 1275 HIV-infected women without prenatal care, quantifying VL to guide delivery resulted in more neonatal HIV infections, fewer cesarean deliveries, increased costs, and decreased QALYs when compared with routine cesarean delivery for all. There were 9 more HIV-infected neonates born to women who were assigned delivery mode based on VL compared with routine cesarean delivery for all (Table 3). Eight of these cases were born to women with high VL and one to a woman with low VL. This strategy increased cost by $3.88 million and decreased effectiveness by 63 QALYs and so would be deemed a nondominant strategy.

Women who were assigned mode of delivery based on VL experienced 171 fewer cesarean deliveries in the first pregnancy and 94 fewer cesareans in

the subsequent pregnancy compared with women who received a routine cesarean delivery in the setting of unknown VL for their first pregnancy (Table 3). There were no observed differences in cesarean delivery–related complications between the 2 strategies. In both strategies, there were no hysterectomies after a second cesarean delivery and no maternal deaths after the first and second deliveries.

Univariate sensitivity analyses were performed on model inputs across a wide range. We found that the largest driver of the model was the vertical transmission rate in women with high VL. With the cost-effectiveness threshold at $100,000 per QALY, VL quantification to guide mode of delivery was cost-effective only when the MTCT rate among women with high VL was below 0.68%; this value is significantly lower than the rate of 16.8% used in our model (Figure 2). Furthermore, when the rate of women with high VL in the population was varied, VL quantification led to improved outcomes when the rate fell below 15% but did not become cost-effective. Next, we varied the OR of vertical transmission via routine cesarean delivery. We found that the point-of-care VL test became cost-effective only when the OR of HIV transmission with routine cesarean delivery as compared with vaginal delivery was greater than 0.885 as compared with the baseline of 0.3. When we individually varied the sensitivity and specificity of the VL test, point-of-care VL quantification remained the nondominant strategy, meaning it resulted in increased cost and decreased effectiveness, even at 100% sensitivity and specificity. We simulated 10,000 trials in a Monte Carlo analysis to simultaneously vary probabilities and costs (Figure 3). Routine cesarean delivery for all was the dominant strategy in 99.7% of the trials.

TABLE 2
Costs, utilities, and life expectancies used in the model

Variable	Value	Range considered in sensitivity analysis	References
Costs			
Point-of-care HIV RNA VL assay (per test)	$15.22	$0–100	12
Annual medical cost of HIV infection	$21,797	$15,000–28,000	27
Cesarean delivery	$13,634	$10,000–16,000	28
Vaginal delivery (excluding labor time)	$7630	$2000–15,000	28
Labor time, nulliparous	$1985	$100–5000	28
Labor time, multiparous	$1388	$100–3000	28
Labor time, TOLAC	$1686	$100–3000	28
Uterine rupture requiring hysterectomy	$2419	$1000–5000	28
Uterine rupture requiring repair	$1041	$800–3000	28
Maternal death (hospital cost)	$4047	$1000–8000	28
Maternal death (lost wages per year)	$41,340	$0–60,000	25
Utilities			
Cesarean delivery	0.996		29
Vaginal delivery	1		Assumed
Maternal death	0		Assumed
Hysterectomy	0.963		28
HIV, age <45 y (neo POV)	0.95		30
HIV, age 45–50 y (neo POV)	0.92		30
HIV (mat POV)	0.88		31, 32
Healthy neonate	1		Assumed
Life expectancy			
Woman with HIV	64.3	64.3–81.2	33
Neonate infected with HIV	50	50–78.8	30
Healthy neonate	78.8	–	34

POV, point-of-view; *TOLAC*, trial of labor after cesarean; *VL*, viral load.

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Discussion

Principal findings

Our model suggests that using a point-of-care HIV RNA VL test to guide mode of delivery in HIV-positive pregnant women without prenatal care is not cost-effective when compared with routine cesarean delivery for all. We have demonstrated that quantifying VL using a point-of-care test at delivery results in more neonatal HIV infections, leading to greater cost and decreased effectiveness.

Results

If the VL assay had optimal performance, meaning 100% sensitivity and specificity, our model suggests that this strategy would still not be cost-effective. This is because even women with a low VL (true negatives) who deliver vaginally have a low rate of perinatal transmission (baseline: 0.9%) and, per our assumption that the OR associated with routine cesarean delivery is the same for women with low and high VL, this risk is further reduced in the cesarean for all strategy. Although the Women and Infants Transmission Study cohort did not observe cases of neonatal HIV infection in women with low VL, subsequent studies do report perinatal transmission even at low levels of HIV RNA.[1,2,40] If we

TABLE 3
Comparison of maternal outcomes associated with point-of-care Xpert HIV-1 viral load test vs routine cesarean delivery for all in a theoretical population of 1275 HIV-positive women with late or no prenatal care

Outcome	POC HIV RNA VL	Cesarean delivery	Difference
Neonatal HIV infection	65	56	↑ 9
High maternal VL	63	55	↑ 8
Low maternal VL	2	1	↑ 1
Cesarean delivery (first pregnancy)	1104	1275	↓ 171
Cesarean delivery (second pregnancy)	648	742	↓ 94
Vaginal delivery (first pregnancy)	171	0	↑ 171
Vaginal delivery (second pregnancy)	626	532	↑ 94
Uterine rupture	1	1	0
Costs	$67,349,091	$63,465,720	↑ $3,883,371
QALYs	93,833	93,896	↓ 63

POC, point of care; *QALYs*, quality-adjusted life years; *VL*, viral load.

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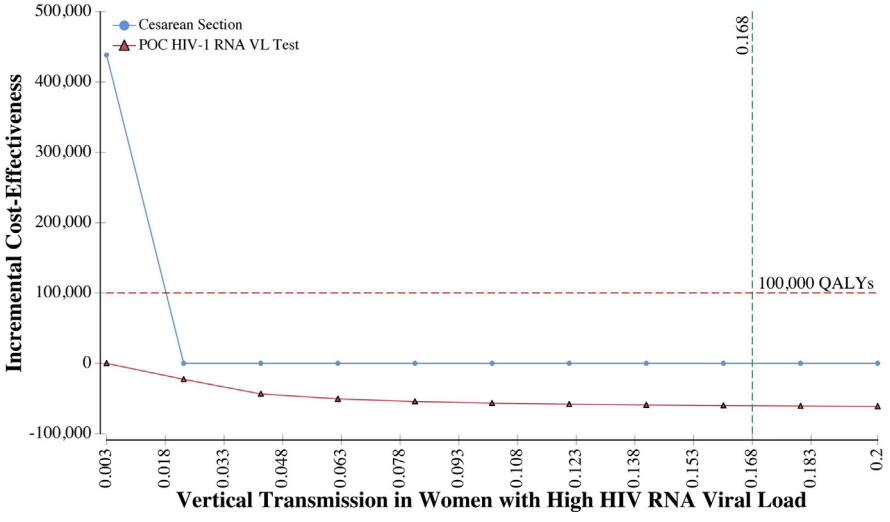
assumed complete viral suppression in women with low VL, quantifying HIV RNA before delivery with the reported test characteristics of this assay would result in false-negative results, leading to women with high VL delivering vaginally. Women with high VL delivering vaginally carry the greatest risk of MTCT and, from an infectious disease prevention standpoint, would benefit most from routine cesarean delivery.

The majority of neonatal HIV infections in the strategies we compared occurred in women with high VL. Furthermore, we observed more infected neonates born to women who received VL quantification to allocate mode of delivery. This outcome resulted from fewer cesarean deliveries in this strategy. Research has demonstrated the protective effects of scheduled cesarean delivery in reducing perinatal transmission and this is reflected in guidelines for managing women with high or unknown VL at delivery.[7,8,40] However, additional benefit of routine cesarean delivery in reducing transmission in women with low VL is unclear and debatable due to the lower level of MTCT in these women.[4,41] For the VL quantification test to be cost-effective in our model, the OR for vertical transmission associated with routine cesarean delivery as compared with vaginal delivery would have to be significantly greater than values reported in literature.[7,8,42] Although we did not observe differences in delivery-related complications, including uterine rupture, hysterectomy, and maternal deaths, we anticipate differences may arise when scaling to populations including more women with HIV. In the HIV RNA VL group, there would need to be an estimated 5000 fewer primary cesarean deliveries to prevent 1 hysterectomy. Furthermore, based on a weighted average, there would need to be 6143 fewer primary cesarean deliveries to prevent 1 maternal death in the first pregnancy. In addition, among HIV-infected women, there is evidence of increased postpartum morbidity associated with cesarean delivery (compared with other modes of delivery) that were outside the scope of outcomes considered in our model.[4,43] Thus, clinical decisions related to risk of transmission and postpartum complications with mode of delivery should weigh risks and benefits for both the pregnant woman and her child, and care should be individualized for all women regardless of VL status.

FIGURE 2
Univariate sensitivity analysis



Univariate sensitivity analysis of incremental cost-effectiveness vs vertical transmission rate in women with high viral load defined as >1000 copies/mL (baseline: 0.168).

QALY, quality-adjusted life year.

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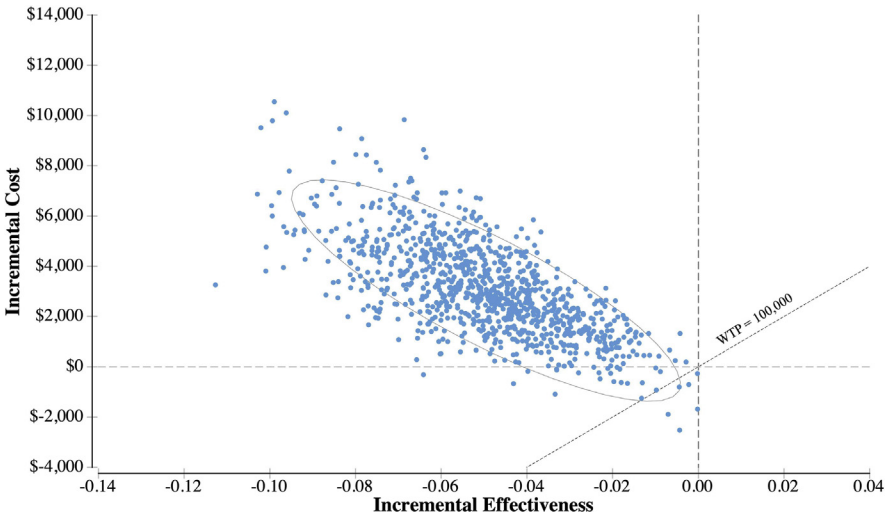
FIGURE 3
Multivariate sensitivity analysis



This Monte Carlo simulation displays outcomes of 10,000 trials. Each dot represents the result of a single trial. The dashed line represents a WTP threshold equal to $100,000 per QALY. The ellipse encloses the single trials with 95% confidence. Routine cesarean delivery was the dominant strategy in 99.7% of trials.

QALY, quality-adjusted life year; *WTP*, willingness-to-pay.

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Clinical implications

A low rate of MTCT in women with high VL was required for VL quantification to be cost-effective in our model. This finding underscores the importance of suppressing infectivity in this cohort by prophylactic interventions such as early prenatal care, HAART, and routine cesarean delivery. Research suggests that HIV-infected women are highly motivated to adhere to HAART during pregnancy to prevent MTCT, and those who initiate treatment before pregnancy are more likely to achieve undetectable VL near delivery.[41,44] A recent surveillance of HIV-infected pregnant women in Philadelphia between 2005 and 2013 found that only one half of deliveries for women with high or unknown VL occurred by routine cesarean delivery.[19] Furthermore, minority women of Hispanic ethnicity and black race were 70% less likely to deliver by routine cesarean delivery when indicated compared with non-Hispanic white women. These data suggest that viral suppression is an achievable goal by addressing barriers to care in early pregnancy and closing practice gaps regarding current recommendations.

Research implications

As mentioned, there is limited information regarding the additional benefit of routine cesarean delivery in reducing the risk of vertical transmission in women with low VL. Additional studies with more robust data on the role of cesarean delivery in reducing transmission in these women is needed. Furthermore, updated costs of perinatal HIV infection to reflect improved life expectancy are required to inform stronger future cost-effectiveness analyses. Going forward, further research on point-of-care HIV RNA VL testing is required in an obstetric population to evaluate test performance and implementation in labor and delivery settings. Future cost-effective analyses may consider analyzing postpartum adherence to HAART and document vertical transmission across two deliveries.

Strengths and limitations

Published literature has established the cost-effectiveness of routine cesarean delivery in preventing perinatal HIV transmission.[30,45,46] Our study applies a low-cost, point-of-care VL quantification test in an obstetric setting with the intent to better inform mode of delivery among HIV-infected pregnant women without prenatal care. Acknowledging the increased morbidity associated with cesarean delivery, we designed a 2-pregnancy model to quantify the downstream impact of the first cesarean delivery on subsequent pregnancies. Additionally, we add to previous analyses by including updated estimates of cost and life-expectancies in the HAART era to reflect the improvement in chronic disease management made possible by treatment advances.[47]

There are several limitations to our research. As with any cost-effectiveness model, the reliability of our results depends on the strength of the probability, cost, and utility estimates available in the literature. For example, we applied the OR associated with routine cesarean delivery to women with both low and high VL, although the evidence of reduction in transmission for women with low VL is unclear.[4,41] Due to limited data, we assumed that the rates of delivery-related complications, such as uterine rupture, hysterectomy, and maternal death, were the same between women with HIV and women without HIV. Our model did not capture the full spectrum of postpartum complications that may more commonly affect HIV-infected women, such as postpartum fever, wound infections, urinary tract infections, endometritis, and hemorrhage.[43] Several of the studies from which we derived inputs may have been subject to low external validity and bias. For instance, data regarding maternal mortality was obtained from a single large study and delivery-related costs were estimated from financial records at a single institution, which may not accurately reflect outcomes in all regions of the United States.[21,43] Lastly, we made assumptions in several of our lifetime costs estimates related to HIV infection and maternal death. Despite these

Glossary

- **Cost-effectiveness analysis**: Economic analysis comparing costs and outcomes of 2 or more interventions.
- **Discounting**: Method of incorporating time preferences when considering future costs and benefits.
- **Incremental cost-effectiveness ratio:** The difference in cost of 2 interventions divided by the difference in effectiveness or quality-adjusted life years.
- **Monte Carlo analysis:** Evaluates multivariable changes in probabilities and costs over a specified range through a simulation of numerous trials.
- **Quality-adjusted life year (QALY):** Utility multiplied by the number of years spent in a particular health state.
- **Sensitivity analysis:** Key variables are varied over a specified range to evaluate changes in results and robustness of model.
- **Utility:** Preference ranging from 0 (minimum, ie, death) to 1 (maximum, ie, perfect health) for a particular health state.
- **Willingness to pay:** Amount consumers are willing to pay for a good or service. The willingness to pay threshold in healthcare analyses is usually $100,000 per QALY.

limitations, univariate sensitivity analyses and Monte Carlo simulations indicated that our model was robust even when inputs were varied significantly across clinically plausible ranges.

Conclusions

In conclusion, our findings suggest that point-of-care VL testing in HIV-infected women without prenatal care is not cost-effective compared with routine cesarean delivery for all women with unknown VL at delivery, even after accounting for downstream impact of a first cesarean delivery. Increasing access to prenatal care, HAART, and following American College of Obstetricians and Gynecologists guidelines regarding routine cesarean delivery can further reduce MTCT risk. Most importantly, cesarean delivery prevention in this population requires access to adequate and timely prenatal care so that VL quantification and suppression can be accomplished before delivery. ■

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Received March 12, 2019; revised June 8, 2019; accepted June 12, 2019.

The authors report no conflict of interest.

E.T. receives support from the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development and National Institutes of Health Office of Research on Women's Health, Oregon BIRCWH Scholars in Women's Health Research across the Lifespan (K12HD043488-14). This is the funding E.T. received for all work done during the period of time that this research and manuscript was generated.

Presented in poster format at the 39th annual pregnancy meeting, Society for Maternal-Fetal Medicine, Las Vegas, NV, Feb. 11—16, 2019.

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