

Research Paper

Cost-benefit analysis of prevention of mother-to-child transmission of HIV services: a contingent valuation study of patients' preferences from clinical pharmacists' perspective

Abdulumminu Isah^{1,*}, Maxwell Ogochukwu Adibe¹,
Chinwe Victoria Ukwé¹, Mathew Jegbefume Okonta^{1,†},
Chukwuemeka Michael Ubaka¹, Deborah Oyine Aluh¹, Abdulrouf Isah²
and Hadiza Usman Ma'aji³

¹Department of Clinical Pharmacy and Pharmacy Management, University of Nigeria, Nsukka, Enugu State, Nigeria,

²Department of Public Administration and Local Government, University of Nigeria, Nsukka, Enugu State, Nigeria and

³Department of Clinical Pharmacy and Pharmacy Practice, Ahmadu Bello University, Zaria, Kaduna State, Nigeria

*Correspondence: Abdulumminu Isah, Department of Clinical Pharmacy and Pharmacy Management, University of Nigeria, Nsukka, 410001, Enugu State, Nigeria. Tel: +234-8036267850; Email: abdulumminu.isah@unn.edu.ng; abdalmumin2@gmail.com.

[†]Deceased.

Received September 17, 2020; Accepted November 16, 2020.

Abstract

Objectives Cost-benefit analysis is the least reported economic analysis of prevention of mother-to-child transmission services. In cost-benefit analysis, consumers' wellbeing is considered from their own perspective. This study determined the benefit-cost ratios of prevention of mother-to-child transmission services in two Nigerian tertiary hospitals.

Methods This was a cross-sectional survey using willingness-to-pay. The study was conducted among patients at Ahmadu Bello University Teaching Hospital and the University of Nigeria Teaching Hospital. Potential benefit was measured as patients' willingness-to-pay while cost was measured from pharmacists' perspective. The benefit-cost ratio for each service was obtained as the average after 1000 iterations of Monte Carlo simulation in a probabilistic sensitivity analysis.

Key findings A total of 219 patients responded to the questionnaires. Most of the patients were married, 149 (68.0%). Primary prevention of HIV had the highest 'yes' willingness-to-pay response of 152 (69.4%). It also had the highest mean willingness-to-pay amount of N7987.42 ± 4542.00, with willingness-to-pay minimum (maximum) amounts of N100 (N500 000). Primary prevention of HIV had the highest return-on-investment for 15 min of hospital pharmacists' salary: benefit-cost ratio 19.286 ± 0.170 (95% CI: 18.954 – 19.618).

Conclusion Primary Prevention of HIV had the highest benefit-cost ratio among the six prevention of mother-to-child transmission services. This suggests that healthcare systems will have the highest return-on-investment if they asked patients to pay for the service.

Keywords: clinical pharmacists; contingent valuation; cost-benefit analysis; patients' preferences; prevention of mother-to-child transmission; return on investment

Introduction

Children who are borne by HIV-infected women are at a high risk of acquiring the infection themselves. It is estimated that almost all the children who are aged 15 years or less (90% of about half a million) and who are confirmed to be infected with HIV annually got the infection through mother-to-child transmission which occurs during pregnancy, labour, and delivery or breastfeeding.^[1] The epidemiology of HIV in children is directly related to that of women. In any sexual relationship, the risk of transmission of HIV infection from males to females is higher than the reverse^[1] by about a 24-fold chance of higher transmission.^[2] The relationship in the similarity of the infectious rate between mothers and their children stems from the fact that, without any form of intervention, there is a risk of an infant acquiring the virus from an infected mother that ranges from 15 to 45%.^[2-4] The industrialized nations have a relatively lower risk (15–25%) compared to the developing nations which have 25–45% probability of infection,^[5] such that above 40% of all live births of children in communities are HIV infected in some of the countries.^[2] The transmission risk varies at the three possible points of infection: the risk is 5–10% during pregnancy, 15% are infected during labour and delivery, while 5–15 % are infected during breastfeeding.

Several studies have been conducted in both low and middle income as well as developed countries on the economic outcome of different antiretroviral regimens for the prevention of mother to child transmission. The outcomes against which the cost-effectiveness of alternative interventions was measured are HIV Infections Averted (HIA), life expectancy, quality-adjusted life years (QALYs), and daily adjusted life years (DALYs).^[6]

Of the different economic analysis conducted about prevention of mother-to-child transmission (PMTCT) services, the least reported in literature is cost-benefit analysis (CBA). In CBA, patients' wellbeing is considered from their own perspective, since utility is measured from their preferences. CBA also has the advantage of allowing the use of different perspectives of cost and outcomes in the economic analysis of interventions. In a UNICEF and Mozambique's Ministry of Health-sponsored study on the CBA of PMTCT, the researchers used monetary units to calculate costs, while they measured benefits as the deaths averted or the disability-adjusted life years by the use of PMTCT services.^[7] They however restricted PMTCT service to the provision (or otherwise) of infant feeding formula, the conduct of HIV counselling and test, as well as the provision of infant prophylaxis with nevirapine at birth. A more robust CBA study was conducted in the Republic of Serbia, as the benefits that they considered included more aspects of the PMTCT services.^[8] According to the World Health Organization (WHO), PMTCT is a conglomerate of different services, with the four cardinal components being primary prevention of HIV in women of reproductive age, the prevention of unintended pregnancies in HIV-positive women, the provision of therapeutic interventions for the mother and her child during pregnancy and delivery, and overall provision of treatment, care and support for the mother and her family before, during and after the pregnancy.^[9]

Pharmacists play a role in the provision of all the PMTCT services to patients.^[10-12] In the prevention of HIV in women, pharmacists provide pharmaceutical services such as counselling on abstinence, safe sexual practices, and provision of drug-related preventive strategies like post-exposure prophylaxis. Pharmacists educate HIV-infected women on family planning programmes involving the use of medical and non-medical devices as well as practices. In the last two PMTCT services, pharmacists play strategic roles in the provision

of the right drug regimens to both the mothers and their children, and selection and maintenance of safe breastfeeding options. The identification of patients' preferences for the different roles of pharmacists in PMTCT services is the focus of this study. The benefit of interest is the patients' choices of the roles that pharmacists play in PMTCT services, while the prices of the services, considering the pharmacists' income, were the costs of interest in this study. Thus, this study was conducted to determine the benefit-cost ratios (BCRs) of the PMTCT services in two Nigerian tertiary health institutions. The specific research question was to identify the return on investment for the PMTCT services among patients in the two hospitals, with the cost determined from the Pharmacists' perspective.

Methods

Study design

This was a cross-sectional survey using the willingness to pay (WTP) strategy of contingent valuation to determine the benefits that patients attach to the different PMTCT services, measured as the return on investment on Pharmacists' earnings.

Study settings and participants

The study was conducted among patients at Ahmadu Bello University Teaching Hospital (ABUTH), Zaria, Kaduna State, and University of Nigeria Teaching Hospital (UNTH), Enugu, Enugu State. The two hospitals were purposively selected for being the first teaching hospitals in their respective geopolitical zones in Nigeria. They were also the first hospitals in their zones to start HIV treatment and care, thus having the largest number of patients. Both hospitals have about 2500 patients each, with the total enrolled for PMTCT at every time being about 150.

All the PMTCT patients of the two hospitals who provided oral consent to participate in the study and met the eligibility criteria were included in the study. It was required that the patients should have enrolled into the PMTCT clinic at any stage of the PMTCT programme: pregnancy or post-partum. Patients recruitment and data collection were simultaneously conducted for three months in 2018, from January to March. They were approached on their clinic days while waiting for their physical assessment at the waiting rooms. Four and seven patients in ABUTH and UNTH, respectively, declined to participate in this study, all of whom gave excuse of not having the time to spare for the study.

Study instrument

A structured WTP questionnaire was designed for this study. The first section of the questionnaire documented some basic socio-economic characteristics of the respondents. The second section contained the WTP questions for the four PMTCT services, viz. primary prevention of HIV in women of reproductive age, prevention of unwanted pregnancies in HIV-positive women, follow-up treatment and support for the pregnant HIV-positive women, and therapeutic intervention around delivery for the women and their families. Two additional services related to the PMTCT were also evaluated. The first was patients' responses for paying for the PMTCT drugs alone, while the second was their responses for paying for specialized clinical pharmacy services throughout the PMTCT programme. For each service, the WTP questions sought to know patients' WTP for the services and the exact amounts that they would want to pay for the service using a payment card. The instrument had earlier been piloted among patients in a Nigerian hospital.^[13]

Benefit estimate

WTP for each of the service was used in estimating the potential benefits of the service to the patients. The WTP was elicited using the questionnaire and a payment card that were interviewer-administered. To commence the study, the concept of the study was introduced to the respondents, after which informed consent was obtained from those that agreed to participate in the study. The meaning of the concept of WTP was fully explained to them. Thereafter, they were requested to ensure that the responses were as truthful as possible, providing real-life prices based on the realities of their income. Because of the nature of this study, periodic guide was provided to the respondents to ensure that the responses that they provided were true reflections of their economic circumstances.

It took about 10 min for each respondent to complete the questionnaire, after which the completed questionnaires were inserted into a brown envelop. The questionnaire completion was done on isolated tables with the permission of the hospital management, to ensure that there was no form of communication during the provision of the responses. Each patient was provided a bottle of water at the end of the session.

Data analysis

The completed questionnaires were coded into Microsoft Excel (2016) and cleared of errors. The responses to the WTP were reported as frequencies and percentages, while their WTP amounts were reported as means, standard error of means, and minimum/maximum. Whereas chi-square test was used to compare categorical data between the hospitals, independent *t*-test was used to compare the difference in the means of their continuous variables. In computing the BCR of each service, the Nigerian hospital pharmacists' perspective was considered.

Cost estimation

The costs of the services were estimated using triangulation estimation as utilized in a CBA study that considered pharmacists' perspective.^[14] With the assumption that it will take a pharmacist 15 min to provide each service including the provision of appropriate pharmaceuticals, the prevailing salaries of the Director of Pharmaceutical Services (the most senior pharmacist in the hospital) and Pharmacist I (the starting point for pharmacists) as at 2018 were taken to be the maximum and minimum salaries respectively. The benefit that the patients accorded to each service was measured as the amount that the patients were willing to pay for 15 min of the Pharmacist's time to provide the particular PMTCT service.

Benefit-cost ratio estimation

The BCR for each service was then obtained as the mean (95% confidence interval) after 1000 iterations of Monte Carlo simulation that was used to remove the uncertainties in both variables (costs and benefits) in a probabilistic sensitivity analysis (PSA). Thus, a point estimate was randomly selected from the distribution that was obtained from the PSA. All prices and costs were obtained in Naira which was equivalent to \$360 as at the time that the study was conducted (January–March 2018). For all the statistical analysis, two-tailed associations were considered with the significance level set at $P < 0.05$.

Ethical consideration

The protocol used in this study was approved by the Health Research and Ethics Committees of the two study sites. Anonymity

was observed in the data collection and report of the findings of this study.

Results

Sociodemographic characteristics

A total of 219 patients responded to the questionnaires, with UNTH contributing 120. Most of the patients were married, 149 (68.0%), with majority of all the patients, 146 (66.7%), declaring that their income was not sufficient to meet their needs. Table 1 contains the sociodemographic characteristics of the patients.

Willingness to pay choices for the prevention of mother-to-child transmission services

Primary prevention of HIV had the highest 'yes' WTP response of 152 (69.4%) from the 219 patients. This was followed by specialized clinical pharmacy services, then therapeutic interventions around delivery, follow-up treatment and support for the women, and PMTCT drugs alone: 115 (52.2%), 113 (51.6%), 110 (50.2%), 110 (50.2%), and 100 (45.7%), respectively. The difference in the responses between patients of both hospitals was significant for primary prevention of HIV ($P = 0.02$) and prevention of unintended pregnancy ($P \leq 0.0001$).

Patients' willingness to pay amounts

Primary prevention of HIV had the highest mean WTP amount of 7987.42, with WTP minimum (maximum) amounts of N100 (N500 000). The least mean WTP amount was declared for specialized clinical pharmacy services: 408.02. In Table 2, the mean WTP amounts for the respondents in both hospitals are presented.

Benefit-cost ratios of patients' willingness to pay choices from Nigerian hospital pharmacists' perspective

Primary prevention of HIV had the highest return on investment for 15 min of Nigerian hospital pharmacists' monthly income: BCR 19.286 ± 0.170 (95 % CI: 18.954 – 19.618). Specialized clinical pharmacy service had the least return on investment, with BCR 0.996 ± 0.008 (95 % CI: 0.980 – 1.013). The BCR of all PMTCT services based on the Nigerian hospital pharmacists' perspective are shown in Table 3.

Discussion

This study determined the benefit that patients accorded to PMTCT services and the return on investment for healthcare providers based on the hospital pharmacists' perspective. It was conducted among PMTCT patients in one tertiary hospital each in the Northern and Southern parts of Nigeria.

The majority of the mothers reported that their income was not sufficient to meet their needs. Most of the mothers expressed a 'yes' WTP response for Primary Prevention of HIV, with the proportion being more than the positive WTP response for other PMTCT services. Whereas Primary Prevention of HIV had the highest BCR value for 15 min of Nigerian hospital pharmacists' monthly income, Specialized Clinical Pharmacy Service had the least BCR value, according to the mothers who responded to the questions on WTP for the PMTCT services.

Table 1 Sociodemographic characteristics of the patients in both hospitals

Characteristics	ABUTH (N = 99)	UNTH (N = 120)	Total (N = 219)	P-values
	<i>n</i> (%)			
Age (Years)				
18–30	29 (29.3)	44 (36.7)	73 (33.3)	≤0.0001*
31–40	36 (36.4)	58 (48.3)	94 (42.9)	
41–50	18 (18.2)	15 (12.5)	33 (15.1)	
51–60	12 (12.1)	3 (2.5)	15 (6.8)	
61–70	4 (4.0)	0 (0.0)	4 (1.8)	
Mean (SD)	38.1 (11.3)	34.6 (7.1)	36.2 (9.3)	0.01*
Marital status				
Single	16 (16.2)	19 (15.8)	35 (16.0)	≤0.0001*
Married	57 (57.6)	92 (76.7)	149 (68.0)	
Separated	2 (2.0)	1 (0.8)	3 (1.4)	
Divorced	7 (7.1)	1 (0.8)	8 (3.7)	
Widowed	17 (17.2)	7 (5.8)	24 (11.0)	
Satisfaction with income				0.11
Not sufficient	65 (65.7)	81 (67.5)	146 (66.7)	
Meets the need	29 (29.3)	25 (20.8)	54 (24.7)	
Allows for savings	5 (5.1)	14 (11.7)	19 (8.7)	
Health status				0.11
Very good	53 (53.5)	43 (35.8)	96 (43.8)	
Good	40 (40.4)	67 (55.8)	107 (48.9)	
Fair	5 (5.1)	8 (6.7)	13 (5.9)	
Bad	1 (1.0)	1 (0.8)	2 (0.9)	
Very bad	0 (0.0)	1 (0.8)	1 (0.5)	
Health insurance				0.03*
No	71 (71.7)	101 (84.2)	172 (78.5)	
Yes	28 (28.3)	19 (15.8)	47 (21.5)	

*Significant at $P < 0.05$.**Table 2** Willingness to pay amounts of patients in both hospitals

PMTCT service	ABUTH		UNTH		Total		P-value
	Mean (SEM)	Min (Max)	Mean (SEM)	Min (Max)	Mean (SEM)	Min (Max)	
Primary prevention of HIV	10867.74 (8047.09)	100 (500 000)	6067.20 (5369.45)	200 (500 000)	7987.42 (4542.00)	100 (500 000)	0.502
Prevention of unintended pregnancy in HIV positive women	1860.53 (626.45)	100 (20 000)	532.05 (27.68)	100 (1500)	986.85 (221.66)	100 (20 000)	≤0.0001*
Follow up treatment and support for HIV positive pregnant women	4453.85 (503.45)	100 (10 000)	3754.24 (268.22)	500 (8500)	4081.98 (276.27)	100 (10 000)	≤0.0001*
Therapeutic intervention around delivery	5258.49 (500.30)	100 (10 000)	3877.05 (247.61)	300 (9000)	4519.30 (274.17)	100 (10 000)	≤0.0001*
PMTCT drugs only	4331.91 (609.73)	200 (20 000)	3094.44 (213.84)	200 (7000)	3670.30 (310.40)	200 (20 000)	≤0.0001*
Specialized clinical pharmacy services	648.57 (200.96)	40 (10 000)	232.09 (28.29)	50 (1000)	408.02 (88.06)	40 (10 000)	0.024*

*Significant at $P < 0.05$.

The BCR of all the PMTCT services were determined from the Nigerian hospital pharmacists' perspective. Primary Prevention of HIV having the highest BCR means that investing in Primary Prevention of HIV will give the highest return on investment (up to 1900%) of all the PMTCT services. In other words, if the hospital should invest one on a pharmacist to spend 15 min on providing the service on the PMTCT patients, the hospital will get N19 in return. However, Specialized Clinical Pharmacy Service had the least BCR of the six services that were evaluated.

The sociodemographic characteristics that were identified in this study are similar to those that have been reported among PMTCT

patients in different studies. Just as there were more married and middle-aged women in this study, a study in Nigeria by Mamudu recorded that their respondents were also majorly married.^[15] The distribution of age and marital status is also corroborated by a Malawian study.^[16] However, most of the respondents in the latter study, a willingness-to-accept (WTA)-WTP study similar to the present, reported a lower monthly household income. Nevertheless, the majority of the respondents in this study stated that their income was not sufficient to meet their needs. Several factors could contribute to the report of insufficient income. One reason is that many of the respondents earned less than the national minimum wage of Nigeria.

Table 3 Benefit-cost ratios of patients' willingness to pay choices from the Nigerian hospital pharmacists' perspective

PMTCT service	Benefit-cost ratios				
	Mean	SD	SEM	95% CI	
				Lower	Upper
Primary prevention of HIV	19.286	5.362	0.170	18.954	19.618
Prevention of unintended pregnancy in HIV positive women	2.402	0.640	0.020	2.362	2.442
Follow up treatment and support for HIV positive pregnant women	9.882	2.732	0.086	9.713	10.051
Therapeutic intervention around delivery	10.955	3.118	0.099	10.762	11.148
PMTCT drugs only	8.957	2.400	0.076	8.809	9.106
Specialized clinical pharmacy services	0.996	0.265	0.008	0.980	1.013

This is the first work that analyzed the CBA of individual components of PMTCT services in any hospital. The present works on CBA for PMTCT services evaluated only routine and voluntary tests for HIV of pregnant women. In an updated report on the CBA of PMTCT in Serbia, it was reported that the additional benefit of detecting a mother's HIV status was such that one diagnosis of a mother saved €34 977.^[8] Alarid-Escudero *et al.* conducted a study among migrants in Central America on the CBA of three HIV prevention interventions, which included voluntary counselling and testing, treatment of sexually transmitted infections, and condom distribution. They reported a return of between 2 and 131 per dollar invested.^[17] In a study in France that analyzed the CBA of HIV programmes in Argentina, Lavadenz *et al.* reported that the BCR of HIV interventions was 1.03.^[18]

It is noted that a limitation of this study is that cost-benefit analysis was conducted in this study using return-on-investment as the measure of BCR. The limitation stems from the fact that return-on-investment is not a complete economic evaluation.^[19] That notwithstanding, it is appropriate in determining consumers' preferences to public services, including healthcare services. Although the study was conducted in Nigeria, thus limiting the generalizability of its findings to other settings, there is the possibility of extrapolating the results to other developing countries that do not fund HIV treatment from public purse. The developed nations who provide funds to the low and middle income countries will also find the results useful in determining the PMTCT service to deploy more efforts.

Conclusion

Primary prevention of HIV was found to have the highest benefit-cost ratio among the six PMTCT services that were considered in this study. This suggests that healthcare systems will have the highest return on investment if they asked patients to pay for the service, if provided by hospital clinical pharmacists. The study is novel in the pharmacoeconomic evaluation of PMTCT services, being the first study to determine the CBA of PMTCT-related services as independent competing alternatives. Other studies lumped up the services as one, but those were just for the WTP. This study has thus set a template to be used, if and when the government is ever to charge PMTCT patients for any of the services.

Author Contributions

Abdulmuminu Isah, Maxwell Ogochukwu Adibe, Chinwe Victoria Ukwé and Mathew Jegbefume Okonta conceptualized the design of the study. Abdulmuminu Isah and Maxwell Ogochukwu Adibe conducted the data analysis and interpreted the results. Chukwuemeka Michael Ubaka and Deborah

Oyine Aluh wrote the first draft of the manuscript. Abdulrouf Isah and Hadiza Usman Ma'aji collected data from respondents and revised the manuscript. All the authors approved the manuscript for submission to the Journal for publication.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of Interest

The authors declare that there is no conflict of interest.

Data availability

The data used for this study is available on reasonable request to the corresponding author.

References

1. Arulogun OS, Adewole IF, Olayinka-Alli L *et al.* Community gate keepers' awareness and perception of prevention of mother-to-child transmission of HIV services in Ibadan, Nigeria. *Afr J Reprod Health* 2007; 11: 67–75.
2. Pokharel N, Shrestha M, Lama S. Awareness on HIV/AIDS and prevention of mother to child transmission of HIV/AIDS among stake holders and people living with HIV/AIDS in Dharan municipality, Sunsari, Nepal. *Int J Nurs Midwifery* 2012; 4: 21–4. doi:10.5897/IJNM11.034
3. De Cock KM, Fowler MG, Mercier E *et al.* Prevention of mother-to-child HIV transmission in resource-poor countries: translating research into policy and practice. *JAMA* 2000; 283: 1175–82.
4. Hussein M, Jira C, Girma B. Assessment of effective coverage of HIV prevention of pregnant mother to child transmission services in jimma zone, South West Ethiopia. *Ethiop J Health Sci* 2011; 21: 1–7.
5. Abdool Karim S, Abdool Karim Q, Adhikari M *et al.* Vertical HIV transmission in South Africa: translating research into policy and practice. *Lancet (London, England)* 2002; 359: 992–3. doi:10.1016/S0140-6736(02)08063-7
6. Karnon J, Orji N. Option B 1 for the prevention of mother-to-child transmission of HIV infection in developing countries : a review of published cost-effectiveness analyses. *Health Policy Plan.* 2016; 31:1133–41. doi:10.1093/heapol/czw025
7. Peffer D, Osman NB, Vaz P. Cost-benefit analysis of a PMTCT program in Mozambique. *Eval Program Plann* 2002; 25: 433–45. doi:10.1016/S0149-7189(02)00054-X
8. United Nations International Children's Emergency Funds. *Cost Benefit Analysis of the Prevention of Mother to Child Transmission of HIV with the Application of the Routine (Universal) and Voluntary Testing*

- for HIV of Pregnant Women by the "OPT-OUT" Model. 2018. <https://www.unicef.org/serbia/media/7671/file/%20The%20prevention%20of%20mother%20to%20child%20transmission%20of%20HIV.pdf> (17 September 2020, date last accessed).
9. World Health Organization. *PMTCT strategic vision 2010–2015 : preventing mother-to-child transmission of HIV to reach the UNGASS and Millennium Development Goals*. 2010. https://www.who.int/hiv/pub/mtct/strategic_vision.pdf (17 September 2020, date last accessed).
 10. Azhar S, Hassali MA, Ibrahim MIM *et al*. The role of pharmacists in developing countries: the current scenario in Pakistan. *Hum Resour Health* 2009; 7: 1–6. doi:10.1186/1478-4491-7-54
 11. Tseng A, Foisy M, Hughes CA *et al*. Role of the pharmacist in caring for patients with HIV/AIDS: clinical practice guidelines. *Can J Hosp Pharm* 2012; 65: 125–44. doi:10.4212/cjhp.v65i2.1120
 12. Bhandari DR, Palaian S, Emirates UA *et al*. Role of pharmacist in counseling HIV infected patients : time to accept our professional responsibility. *Pharma Rev* 2006: 145–50.
 13. Isah A, Adibe MO, Anosike C *et al*. Willingness-to-accept and willingness-to-pay ratios of prevention of mother-to-child transmission services in a Nigerian hospital: a cross-sectional contingent valuation study. *Value Heal Reg Issues*. 2019; 19: 112–21. doi:10.1016/j.vhri.2019.05.001
 14. Ezennia IJ, Nduka SO, Ekwunife OI. Cost benefit analysis of malaria rapid diagnostic test : the perspective of Nigerian community pharmacists. *Malar J* 2017; 16: 1–10. doi:10.1186/s12936-016-1648-0
 15. Mamudu RA. *Knowledge Attitude and Practices of Prevention of Mother to Child Transmission of HIV(PMTCT) among women of Child Bearing Age, in Karu Village, Abuja, Nigeria*. M.Phil Thesis, Stellenbosch University, Stellenbosch, South Africa, 2014.
 16. Chiwaula LS, Chirwa GC, Caltado F *et al*. The value of informal care in the context of option B+ in Malawi: a contingent valuation approach. *BMC Health Serv Res* 2016; 16: 136. doi:10.1186/s12913-016-1381-y
 17. Alarid-Escudero F, Sosa-Rubí SG, Fernández B *et al*. Análisis de costo-beneficio: prevención del VIH/sida en migrantes en centroamérica. *Salud Publica Mex* 2013; 55: S23–S30. doi:10.21149/spm.v55s1.5094
 18. Lavadenz F, Pantanali C, Zeballos E *et al*. Cost-Benefit Analysis of the HIV/AIDS Program in Argentina. Thirty years HIV/AIDS epidemic argentina an assess. *Natl Heal Response* 2015. https://elibrary.worldbank.org/doi/10.1596/978-1-4648-0596-7_ch7 (1 September 2020, date last accessed).
 19. Arenas-Guzman R, Tosti A, Hay R *et al*. Pharmacoeconomics - An aid to better decision-making. *J Eur Acad Dermatology Venereol* 2005; 19: 34–9. doi:10.1111/j.1468-3083.2005.01285.x