

# Peripartum traditional medicine use and surgical site infections: A prospective cohort of women delivering via cesarean section in rural Rwanda

Laban Bikorimana (✉ [bilab1234567@gmail.com](mailto:bilab1234567@gmail.com))

Partners In Health/Inshuti Mu Buzima

**Andrew Oryono**

Partners In Health/Inshuti Mu Buzima

**Elizabeth Miranda**

Program in Global Surgery and Social Change, Harvard Medical School, Boston

**Anne Niyigena**

Partners In Health/Inshuti Mu Buzima

**Barnabas Alayande**

University of Global Health Equity

**Mathieu Niyonkuru**

Partners In Health/Inshuti Mu Buzima

**Andreas S. Goodman**

Department of Global Health and Social Medicine, Harvard Medical School, Boston

**Fredrick Kateera**

Partners In Health/Inshuti Mu Buzima

**Robert Riviello**

Center for Surgery and Public Health, Brigham and Women's Hospital, Boston

**Sadoscar Hakizimana**

Partners In Health/Inshuti Mu Buzima

**Adeline Boatin**

Program in Global Surgery and Social Change, Harvard Medical School, Boston

**Christian Mazimpaka**

Partners In Health/Inshuti Mu Buzima

**Bethany Hedt-Gauthier**

Department of Global Health and Social Medicine, Harvard Medical School, Boston

---

## Research Article

**Keywords:** Africa, Global Surgery, Pregnancy, Traditional Healers

**Posted Date:** November 3rd, 2021

**DOI:** <https://doi.org/10.21203/rs.3.rs-1013681/v1>

**License:**  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

---

**Peripartum traditional medicine use and surgical site infections: A prospective cohort of women delivering via cesarean section in rural Rwanda**

Laban Bikorimana<sup>1†</sup>, Andrew Oryono<sup>1†</sup>, Elizabeth Miranda<sup>2</sup>, Anne Niyigena<sup>1</sup>, Barnabas Alayande<sup>2,3</sup>, Mathieu Niyonkuru<sup>1</sup>, Andrea S. Goodman<sup>4</sup>, Fredrick Kateera<sup>1</sup>, Robert Riviello<sup>2,3,4,5</sup>, Sadoscar Hakizimana<sup>1</sup>, Adeline Boatin<sup>4,6</sup>, Christian Mazimpaka<sup>1</sup>, Bethany Hedt-Gauthier<sup>2,4</sup>

†Laban Bikorimana and Andrew Oryono hold joint first authorship.

1. Partners In Health/Inshuti Mu Buzima, Kigali, Rwanda
2. Program in Global Surgery and Social Change, Harvard Medical School, Boston, USA
3. University of Global Health Equity Rwanda
4. Department of Global Health and Social Medicine, Harvard Medical School, Boston, USA
5. Center for Surgery and Public Health, Brigham and Women's Hospital, Boston, USA
6. Department of Obstetrics and Gynecology, Massachusetts General Hospital, Boston, USA

**Corresponding Author:** Laban Bikorimana, lbikorimana@pih.org, PIH/IMB, +250 788692910

## **Abstract**

### **Background**

Traditional medicine is commonly used in low- and middle-income countries (LMICs). Little is known about the use of traditional medicine among women undergoing cesarean section (c-section) and the association to surgical site infections (SSIs) in LMICs. In this study, we describe peripartum use of traditional medicines and the risk of SSIs among women delivering via c-section in rural Rwanda.

### **Methods**

This prospective cohort study enrolled women who underwent c-section at Kirehe District Hospital in rural Rwanda between September 2019 and February 2020. We collected self-reported data regarding traditional medicine use before and during pregnancy and after discharge up to postoperative day (POD) 11. On POD 11 (+/- 3 days), the women returned to the hospital for a study follow-up visit. We used Fisher's exact test to assess the relationship between sociodemographic characteristics and traditional medicine use, and logistic regression to determine the association between traditional medicine use and SSI development while controlling for confounders.

### **Results**

Of the 841 women enrolled in this study, 45 (5.4%) reported using traditional medicine to get pregnant. Nearly 39% used traditional medicine during pregnancy; the majority (96.9%) for a pregnancy-related reason. Only four women (0.5%) reported traditional medicine use between c-section and the POD 11 study visit. Of the 775 women who responded at all time-points, 341

(44.0%) reported using traditional medicine at some point during pregnancy or c-section recovery. No demographic characteristics were significantly associated with traditional medicine use ( $p > 0.05$ ), except for smoking ( $p = 0.048$ ) and alcohol consumption ( $p = 0.010$ ). Both traditional medicine use during pregnancy ( $p = 0.04$ , aOR=2.0, 95% CI: 1.05, 3.85) and at any time point ( $p = 0.04$ , aOR=2.0, 95% CI: 1.04, 3.83) were associated with development of SSI.

### **Conclusions**

Traditional medicine use among c-section patients was high in the peripartum period, particularly during pregnancy, and was significantly associated with SSI. Knowing patterns of traditional medicine use during the peripartum period can help providers collaborate with traditional healers and give appropriate, culturally-sensitive pregnancy and postoperative care and counseling to patients.

**Key words:** Africa, Global Surgery, Pregnancy, Traditional Healers

## **Background**

While still high, there have been notable declines in maternal mortality ratios in sub-Saharan Africa over the last 20 years, from 870 deaths per 100,000 live births in 2000 to 533 deaths per 100,000 live births in 2017 [1]. Increased access to safe cesarean section (c-section) delivery has contributed to this decline [1,26]. However, c-sections can result in complications, including, most commonly, surgical site infections (SSIs); in sub-Saharan Africa, the reported rate of SSIs after c-section has ranged from 6.8% to 26% [4,8,10,12,13,21,27].

The World Health Organization defines traditional medicine as “the knowledge, skills and practices based on the theories, beliefs and experiences indigenous to different cultures, used in the maintenance of health and in the prevention, diagnosis, improvement or treatment of physical and mental illness” [2]. In Africa, up to 80% of people use traditional medicine as a core part of their health care [2]. Factors associated with traditional medicine use in Africa include lower educational status, knowledge of traditional medicine, low socioeconomic status, older age, large family size, unemployment, and rural residence [6,23,19,35]

There is limited information about the use of traditional medicine by women delivering via c-section in sub-Saharan Africa. Some patients undergoing other surgeries, including orthopedic, general, and gynecology surgeries, in South Africa reported using traditional medicine during recovery [33]. Additionally, some literature in sub-Saharan Africa reports that women use traditional medicines to get pregnant or during their pregnancies, and there has been an association between traditional medicine use and poor pregnancy outcomes [14,16].

However, we are unaware of studies describing the use of traditional medicine in the context of post-c-section care in sub-Saharan Africa or the relationship to the development of SSIs.

In Rwanda, 12% of women nationally and 9% in rural areas deliver via c-section [37]. A study in rural Rwanda estimated post-c-section SSI prevalence at 10.9% [34]. Between 50-80% of women in rural Rwanda reported using traditional medicine during pregnancy both to treat symptoms as well as to maintain the mothers' health during her pregnancy [9]; however, the use of traditional medicine after c-section is unknown.

## **Methods**

This study was nested within a larger prospective cohort study that included all c-section deliveries performed at Kirehe District Hospital between September 2019 and February 2020 [34].

### **Study setting**

Kirehe District Hospital (KDH), located in the rural Eastern Province of Rwanda, is managed by the Rwandan Ministry of Health in partnership with the international nongovernmental organization Partners In Health. The hospital has a catchment area of 19 health centers, of which two are located in the Mahama Refugee Camp, and serves a population of approximately 360,000 [30]. In November 2019, KDH had a 233-bed capacity and was staffed by 136 employees, including one Obstetrician/Gynecologist, 15 general practitioners, 77 nurses, and 11 midwives [34].

Women with uncomplicated labor usually deliver at their nearest health center, but those with complications are transferred to the district hospital for delivery. The majority of c-sections in this

study were performed by general practitioners, with specialist intervention when necessary. Most of the patients in the Kirehe catchment area have community-based health insurance; the contribution of community-based health insurance is based on the household's annual income with people in lowest category fully covered without any medical costs and others paying 10% of health care costs.

### **Study population**

This study included all women who underwent c-section at KDH from September 2019 to February 2020 and were permanent residents of Kirehe District. Patients from outside Kirehe District, patients from the Mahama refugee camp, and those who were not discharged from hospital by postoperative day (POD) 10 were excluded from this study. There were no age restrictions.

### **Data collection**

We used multiple sources of data, including patient self-reported data collected through in-person or phone-based interviews, patients' clinical charts, and physical examinations. On POD 1, data collectors consented and enrolled patients in the study and collected information on clinical and sociodemographic characteristics. Data collectors also asked about traditional medicine use before and during pregnancy. On the day of discharge (typically POD 3), data collectors extracted clinical data from the patient's files. On POD 11 (+/- 3 days), the patient returned to the hospital for a study specific follow-up visit. Women received a voucher to cover the costs of transport. At the visit, a general practitioner completed a physical examination to detect the presence or absence of SSI. The data collector asked the mother about traditional medicine use since time of discharge.

Data collectors entered data directly into REDCap, and all data were routinely audited and cleaned by the study managers.

### **Data analysis**

We analyzed patients' sociodemographic and clinical characteristics using frequencies and percentages. We assessed the relationship between sociodemographic characteristics and traditional medicine use as well as the relationship between traditional medicine use and SSI development using Fisher's exact tests. We assessed whether the use of traditional medicine was associated with SSI using logistic regression controlling for possible confounders, evaluated at the  $\alpha=0.05$  significant level. We used Stata version 16 for data cleaning and analysis.

### **Ethics**

To ensure patients' confidentiality, we used patient identification numbers and did not link any personal identifiers to the data. Data were stored in an encrypted, password protected computer. Prior to the implementation of the study, we obtained ethical approval from the Rwanda National Ethics Committee (IRB 326RNEC/2019) and Harvard Medical School (IRB18-1033), and technical approvals from the Rwandan Ministry of Health and the Partners In Health/Rwanda Research Committee.

### **Results**

Of the 841 women enrolled in this study, 249 (29.6%) were 30 years or older (Table 1). Over two-thirds of the women (n=566, 67.4%) completed at least primary education, with an additional 192 women (22.9%) completing secondary education or more. Most of the women (n=714, 84.9%)

were farmers. Nearly all (n=795, 94.5%) had public insurance and an additional 39 (4.6%) had other types of insurance.

**Table 1:** Sociodemographic and clinical characteristics of study participants (N=841)

In this study, 45 (5.4%) women reported using traditional medicine to get pregnant (Table 2).

Of the 829 responding, 321 (38.7%) had used traditional medicine during pregnancy; the majority (n=311, 96.9%) for a pregnancy-related reason. Only four women (0.5%) reported using traditional medicine between c-section and the POD 11 study visit. Of the 775 women who responded to questions at all time-points, 341 (44.0%) reported traditional medicine use at some point during pregnancy or c-section recovery.

**Table 2:** Use of traditional medicine among women delivering via c-section

None of the demographic characteristics were significantly associated with traditional medicine use ( $p>0.05$ ), except for smoking ( $p=0.048$ ) and drinking ( $p=0.010$ ) (Table 3). Both traditional medicine use during pregnancy ( $p=0.035$ , aOR=2.0, 95% CI: 1.05, 3.85) and at any time point ( $p=0.038$ , aOR 2.0, 95% CI:1.04, 3.83) were associated with development of SSI (Table 4).

**Table 3:** Sociodemographic associated with traditional medicine use in post-Cesarean section

**Table 4:** The association between traditional medicine use after cesarean section and the development of SSI.

## **Discussion**

In our study of women delivering via c-section in rural Rwanda, we found that over 40% of women used traditional medicine peripartum, the majority during their pregnancy for pregnancy-related

reasons. A recent systematic review conducted in sub-Saharan Africa found traditional medicine use during pregnancy ranged from 6.5% to 79.9% [15]. High traditional medicine use during pregnancy in Africa has been attributed to pregnant women perceiving that traditional medicine is more accessible and affordable than orthodox medicine [38,39]. In sub-Saharan African, the ratio of traditional healers who operate within rural communities is 1:500, while the ratio of medical doctors is only 1: 40,000, as they primarily reside in urban areas [5]

We found that only 5% of women used traditional medicine to get pregnant. Studies carried out in Uganda and Zimbabwe reported high prevalence of traditional medicine use (76.2% and 36.5%, respectively) in the treatment of infertility conditions [20,22]. The higher prevalence in these other studies could be attributed to patient selection bias, as those studies recruited only non-pregnant women seeking care for infertility, as opposed to our study which recruited women post-delivery. Only four women (0.5%) reported traditional medicine use in the postpartum period, which was considerably lower compared to a study of women who delivered via vaginal and c-section delivery in Zimbabwe (postpartum traditional medicine use of 17.3%) [24]. The difference in prevalence may be due to the different study settings; however, we hypothesize that our traditional medicine use rates were underreported, possibly due to desirability bias when reporting at the study follow-up visit.

We also found that peripartum traditional medicine use was associated with increased risk of SSI, even when controlling for education, smoking, and alcohol use. These results are consistent with findings in Zimbabwe, where 33% of women experienced harmful adverse events due to traditional medicine use during pregnancy [24]. While some research suggests that traditional

medicine can support wound healing [40], the specific herbs and traditional medicines must be studied carefully in this context before encouraging its use. We must emphasize that most of the traditional medicine use reported was in pregnancy, and therefore the full mechanism linking traditional medicine use to SSIs, the possibility of underreporting use in the postpartum period, and SSI risk must be further explored.

### **Limitations**

There are several limitations to consider when interpreting these results. First, women reported traditional medicine use while in a clinical setting, in close proximity to nurses and doctors. Given the negative attitudes towards traditional medicine among healthcare professionals, patients may have been reluctant to disclose this information in this setting. During the course of this study, loss to follow up occurred at different data collection time points leading to exclusion of women with missing data in our analysis. Finally, our study was conducted at one district hospital in Rwanda and may have limited generalizability. However, given that most district hospitals in Rwanda and in the region are located in rural settings with similar population characteristics, these results can be extrapolated to other similar settings.

### **Conclusions**

The peripartum use of traditional medicine is high and significantly correlated with development of SSIs among women delivering via c-section in rural Rwanda. Additional studies regarding traditional medicine use should be carried out to better understand these links, ideally collecting data in non-clinical settings to avoid desirability and reporting biases. Knowing patterns of traditional medicine use can help providers collaborate with traditional healers and give appropriate, culturally-sensitive postoperative care and counseling to patients.

## **List of Abbreviations**

KDH- Kirehe District Hospital

POD- Post-operative day

SSI- Surgical site infection

TMU- traditional medicine use

## **Declarations**

### **Ethics approval and consent to participate**

Ethical approval was obtained from the Rwanda National Ethics Committee (IRB 326RNEC/2019) and Harvard Medical School (IRB18-1033), and technical approvals from the Rwandan Ministry of Health and the Partners In Health/Rwanda Research Committee, and informed consent was obtained from enrolled patients by data collectors.

All methods were performed in accordance with the Declaration of Helsinki and relevant guidelines and regulations.

### **Consent for publication**

Not applicable

### **Availability of data and materials**

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

### **Competing interests**

The authors declare that they have no competing interests.

**Funding:** The data collection for this project was funded by the National Institutes of Health (R21TW011229).

**Author Contributions:** LB and AO led all aspects of the study, with mentorship from EM, BA, and BHG. LB, EM, AN, and MN supported data collection. AG, FK, RR, SH, AB, CM, and BHG provided input on the study design, questions, and interpretation. All authors read and approved the final draft of the manuscript.

**Acknowledgements:** We acknowledge Partners In Health/Inshuti Mu Buzima for the support of this work. This study was conducted under the Partners In Health/Inshuti Mu Buzima Intermediate Operational Research Program, developed and facilitated by Bethany Hedt-Gauthier, Ann C. Miller, and Dale A. Barnhart. Bethany Hedt-Gauthier, Elizabeth Miranda, and Barnabas Alayande provided direct mentorship to this paper as part of training.

## References

1. World Health Organization. National policy on traditional medicine and regulation of herbal medicines: Report of a WHO global survey. World Health Organization; 2005.
2. World Health Organization. Report of WHO interregional workshop on the use of traditional medicine in primary health care, Ulaanbaatar, Mongolia, 23-26 August 2007.
3. World Health Organization. Trends in maternal mortality 2000 to 2017: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division.
4. Ngaroua, Ngah JE, Bénét T, Djibrilla Y. Incidence des infections du site opératoire en Afrique sub-saharienne: revue systématique et méta-analyse [Incidence of surgical site infections in sub-Saharan Africa: systematic review and meta-analysis]. *Pan Afr Med J.* 2016 Jun 29;24:171. French. doi: 10.11604/pamj.2016.24.171.9754. PMID: 27795768; PMCID: PMC5072885.
5. Abdullahi AA. Trends and challenges of traditional medicine in Africa. *Afr J Tradit Complement Altern Med.* 2011;8(5 Suppl):115-23. doi: 10.4314/ajtcam.v8i5S.5. Epub 2011 Jul 3. PMID: 22754064; PMCID: PMC3252714.
6. Ahmed M, Hwang JH, Hasan MA, Han D. Herbal medicine use by pregnant women in Bangladesh: a cross-sectional study. *BMC Complement Altern Med.* 2018 Dec 13;18(1):333. doi: 10.1186/s12906-018-2399-y. PMID: 30545348; PMCID: PMC6293557.
7. Ahmed SM, Nordeng H, Sundby J, Aragaw YA, de Boer HJ. The use of medicinal plants by pregnant women in Africa: A systematic review. *J Ethnopharmacol.* 2018 Oct 5;224:297-313. doi: 10.1016/j.jep.2018.05.032. Epub 2018 May 26. PMID: 29842963.

8. Amenu D, Belachew T, Araya F. Surgical site infection rate and risk factors among obstetric cases of jimma university specialized hospital, southwest ethiopia. *Ethiop J Health Sci.* 2011 Jul;21(2):91-100. doi: 10.4314/ejhs.v21i2.69049. PMID: 22434989; PMCID: PMC3275863.
9. Beste J, Asanti D, Nsabimana D, Anastos K, Mutimura E, Merkatz I, Sirotin N, Nathan LM. Use of Traditional Botanical Medicines During Pregnancy in Rural Rwanda. *J Glob Health Perspect.* 2015;2015:<http://jglobalhealth.org/article/use-of-traditional-botanical-medicines-during-pregnancy-in-rural-rwanda/>. Epub 2015 Jan 25. PMID: 26550548; PMCID: PMC4634644.
10. Brisibe SF, Ordinioha B, Gbeneolol PK. The effect of hospital infection control policy on the prevalence of surgical site infection in a tertiary hospital in South-South Nigeria. *Niger Med J.* 2015 May-Jun;56(3):194-8. doi: 10.4103/0300-1652.160393. PMID: 26229228; PMCID: PMC4518336.
11. Chemouni B. The political path to universal health coverage: Power, ideas and community-based health insurance in Rwanda. *World Dev* 2018; 106: 87-98, [\(https://doi.org/10.1016/j.worlddev.2018.01.023\)](https://doi.org/10.1016/j.worlddev.2018.01.023). (<https://www.sciencedirect.com/science/article/pii/S0305750X18300330>)
12. Chu K, Maine R, Trelles M. Cesarean section surgical site infections in sub-Saharan Africa: a multi-country study from Medecins SANS Frontieres. *World J Surg.* 2015;39(2):350–355.
13. De Nardo P, Gentilotti E, Nguhuni B, Vairo F, Chaula Z, Nicastri E, Nassoro MM, Bevilacqua N, Ismail A, Savoldi A, Zumla A, Ippolito G. Post-caesarean section surgical site infections at a Tanzanian tertiary hospital: a prospective observational study. *J Hosp*

- Infect. 2016 Aug;93(4):355-9. doi: 10.1016/j.jhin.2016.02.021. Epub 2016 Mar 11. PMID: 27125664.
14. Duru CB, Uwakwe KA, Chinomnso NC. Socio-demographic determinants of herbal medicine use in pregnancy among nigerian women attending clinics in a tertiary hospital in Imo State, South-East, Nigeria. *Am J Med Stud.* 2016; 4:1–10.
  15. El Hajj M, Holst L. Herbal Medicine Use During Pregnancy: A Review of the Literature With a Special Focus on Sub-Saharan Africa. *Front Pharmacol.* 2020 Jun 9;11:866. doi: 10.3389/fphar.2020.00866. PMID: 32581815; PMCID: PMC7296102.
  16. Fakeye TO, Adisa R, Musa IE. Attitude and use of herbal medicines among pregnant women in Nigeria. *BMC Complement Altern Med.* 2009 Dec 31;9:53. doi: 10.1186/1472-6882-9-53. PMID: 20043858; PMCID: PMC2808296.
  17. Kassebaum NJ, Barber RM, Bhutta ZA, Dandona L, Gething PW, Hay SI, Kinfu Y, Larson HJ, Liang X, Lim SS, Lopez AD. Global, regional, and national levels of maternal mortality, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. *The Lancet.* 2016 Oct 8;388(10053):1775-812.
  18. Gong SP, Guo HX, Zhou HZ, Chen L, Yu YH. Morbidity and risk factors for surgical site infection following cesarean section in Guangdong Province, China. *Journal of Obstetrics and Gynaecology Research.* 2012 Mar;38(3):509-15.
  19. James PB, Wardle J, Steel A, Adams J. Traditional, complementary and alternative medicine use in Sub-Saharan Africa: a systematic review. *BMJ global health.* 2018; 3 (5): e000895.
  20. James PB, Taidy-Leigh L, Bah AJ, Kanu JS, Kangbai JB, Sevalie S. Prevalence and correlates of herbal medicine use among women seeking Care for Infertility in Freetown, Sierra Leone. *Evidence-Based Complementary and Alternative Medicine.* 2018 Apr 22;2018.

21. Jido TA, Garba ID. Surgical-site infection following cesarean section in Kano, Nigeria. *Annals of medical and health sciences research*. 2012;2(1):33-6.
22. Kaadaaga HF, Ajeani J, Ononge S, Alele PE, Nakasujja N, Manabe YC, Kakaire O. Prevalence and factors associated with use of herbal medicine among women attending an infertility clinic in Uganda. *BMC complementary and alternative medicine*. 2014 Dec;14(1):1-6.
23. Laelago T, Yohannes T, Lemango F. Prevalence of herbal medicine use and associated factors among pregnant women attending antenatal care at public health facilities in Hossana Town, Southern Ethiopia: facility based cross sectional study. *Archives of Public Health*. 2016 Dec;74(1):1-8.
24. Mawoza T, Nhachi C, Magwali T. Prevalence of traditional medicine use during pregnancy, at labour and for postpartum care in a rural area in Zimbabwe. *Clinics in mother and child health*. 2019;16(2).
25. Maver T, Maver U, Stana Kleinschek K, Smrke DM, Kreft S. A review of herbal medicines in wound healing. *International Journal of Dermatology*. 2015 Jul;54(7):740-51.
26. Molina G, Esquivel MM, Uribe-Leitz T, Lipsitz SR, Azad T, Shah N, Semrau K, Berry WR, Gwande AA, Weiser TG, Haynes AB. Avoidable maternal and neonatal deaths associated with improving access to caesarean delivery in countries with low caesarean delivery rates: an ecological modelling analysis. *The Lancet*. 2015 Apr 27;385:S33.
27. Mpogoro FJ, Mshana SE, Mirambo MM, Kidenya BR, Gumodoka B, Imirzalioglu C. Incidence and predictors of surgical site infections following caesarean sections at Bugando Medical Centre, Mwanza, Tanzania. *Antimicrob Resist Infect Control*. 2014 Aug 11;3:25. doi: 10.1186/2047-2994-3-25. PMID: 25126415; PMCID: PMC4131772.
28. Mudonhi N, Nunu WN. Traditional medicine utilisation and maternal complications during antenatal care among women in Bulilima, Plumtree, Zimbabwe. *Maternal Health, Neonatology and Perinatology*. 2021 Dec;7(1):1-9.

29. Mudonhi N, Nunu WN, Sibanda N, Khumalo N. Exploring traditional medicine utilisation during antenatal care among women in Bulilima District of Plumtree in Zimbabwe. *Scientific Reports*. 2021 Mar 25;11(1):1-9.
30. National Institute of Statistics of Rwanda (NISR), Ministry of Finance and Economic Planning (MINECOFIN) [Rwanda];2012. Rwanda Fourth Population and Housing.
31. Mureyi DD, Monera TG, Maponga CC. Prevalence and patterns of prenatal use of traditional medicine among women at selected harare clinics: a cross-sectional study. *BMC complementary and alternative medicine*. 2012 Dec;12(1):1-7.
32. National Institute of Statistics of Rwanda (NISR)[Rwanda], Ministry of Health (MOH)[Rwanda], ICF International. Rwanda Demographic and Health Survey 2019–20 Key Indicators Report.
33. Nethathe GD, Matamba T, Malumalu J, Dladla N, Bayibayi T, Russell SL. Traditional medicine use in surgical patients in a South African tertiary hospital. *Southern African Journal of Anaesthesia and Analgesia*. 2016 Jan 1;22(3):89-92.
34. Nkurunziza T, Kateera F, Sonderman K, Gruendl M, Nihiwacu E, Ramadhan B, Cherian T, Nahimana E, Ntakiyiruta G, Habiyakare C, Ngamije P, Matousek A, Gaju E, Riviello R, Hedt-Gauthier B. Prevalence and predictors of surgical-site infection after caesarean section at a rural district hospital in Rwanda. *Br J Surg*. 2019 Jan;106(2):e121-e128. doi: 10.1002/bjs.11060. PMID: 30620071; PMCID: PMC7938824.
35. Nyeko R, Tumwesigye NM, Halage AA. Prevalence and factors associated with use of herbal medicines during pregnancy among women attending postnatal clinics in Gulu district, Northern Uganda. *BMC Pregnancy Childbirth*. 2016 Oct 6;16(1):296. doi: 10.1186/s12884-016-1095-5. PMID: 27716105; PMCID: PMC5053208.
36. Kristian Opøien H, Valbø A, Grinde-Andersen A, Walberg M. Post-cesarean surgical site infections according to CDC standards: rates and risk factors. A prospective cohort study. *Acta obstetricia et gynecologica Scandinavica*. 2007 Jan 1;86(9):1097-102.

37. Shireen A, Staveteig S, and Birungi F. 2018. Trends in Maternal Health in Rwanda: Further Analysis of the 2014-15 Demographic and Health Survey. DHS Further Analysis Reports No. 108. Rockville, Maryland, USA: ICF.
38. Bayisa B, Tatiparthi R, Mulisa E. Use of herbal medicine among pregnant women on antenatal care at nekemte hospital, Western ethiopia. Jundishapur J Nat Pharm Prod. 2014 Sep 15;9(4):e17368. doi: 10.17795/jjnpp-17368. PMID: 25625049; PMCID: PMC4302397.
39. Ahmed SM, Nordeng H, Sundby J, Aragaw YA, de Boer HJ. The use of medicinal plants by pregnant women in Africa: A systematic review. J Ethnopharmacol. 2018 Oct 5;224:297-313. doi: 10.1016/j.jep.2018.05.032. Epub 2018 May 26. PMID: 29842963.
40. Fazil M, Nikhat S. Topical medicines for wound healing: A systematic review of Unani literature with recent advances. J Ethnopharmacol. 2020 Jul 15;257:112878. doi: 10.1016/j.jep.2020.112878. Epub 2020 Apr 20. PMID: 32325180.