





















## ACKNOWLEDGEMENTS

The authors appreciate the support of the Zambian Ministry of Health at the National, Provincial, and District levels, as well as the traditional leadership of the relevant areas. We would also like to thank Denson Chongwe and Parker S. Chastain who played an integral role in project management and implementation, and Kathleen L. McGlasson who managed the incoming data.

## FUNDING INFORMATION

This program was developed and implemented in collaboration with Merck for Mothers, Merck's 10-year, \$500 million initiative to help create a world where no woman dies giving life. Merck for Mothers is known as MSD for Mothers outside the United States and Canada (MRK 1846-06500. COL). The development of this article was additionally supported in part by the Bill & Melinda Gates Foundation (OPP1130329) <https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database/Grants/2015/07/OPP1130329> and The ELMA Foundation (ELMA-15-F0017) <http://www.elmaphilanthropies.org/the-elma-foundation/>. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. The content is solely the responsibility of the authors and does not necessarily reflect positions or policies of Merck, the Bill & Melinda Gates Foundation, or The ELMA Foundation.

## COMPETING INTERESTS

The authors have no competing interests to declare.

## AUTHOR CONTRIBUTIONS

NAS, DHH, PCR, TV, GB conceptualized study, designed methodology, and oversaw investigation and data acquisition. TN, KKM, MB, VS, JLK implemented the interventions and oversaw project administration. JLK and AJ conducted the data analysis and verified the underlying data. TV, NAS, and JLK wrote the original draft of this manuscript. All authors reviewed and edited the manuscript and approved the final version. All authors had access to the data.

## AUTHOR AFFILIATIONS

**Taryn Vian, PhD, MSc**  [orcid.org/0000-0002-6968-7002](https://orcid.org/0000-0002-6968-7002)

School of Nursing and Health Professions, University of San Francisco, San Francisco, CA, US; WHO Collaborating Centre for Governance, Accountability, and Transparency in the Pharmaceutical Sector, University of Toronto, US

**Jeanette L. Kaiser, MPH**  [orcid.org/0000-0001-6008-5219](https://orcid.org/0000-0001-6008-5219)

Department of Global Health, Boston University School of Public Health, Boston, MA, US

**Thandiwe Ngoma, MPH**

Department of Research, Right to Care Zambia, Lusaka, ZM

**Allison Juntunen, MPH**  [orcid.org/0000-0001-8877-5107](https://orcid.org/0000-0001-8877-5107)

Department of Global Health, Boston University School of Public Health, Boston, MA, US

**Kaluba K. Mataka, MSc**

Zenysis Technologies, Lusaka, ZM

**Misheck Bwalya, MPM**

Mothers2mothers (m2m), Lusaka, ZM

**Viviane I. R. Sakanga, MPH**

Amref Health Africa, Lusaka, ZM

**Peter C. Rockers, ScD, MPH**

Department of Global Health, Boston University School of Public Health, Boston, MA, US

**Davidson H. Hamer, MD, FACP, FIDSA, FASTMH, FISTM**  [orcid.org/0000-0002-4700-1495](https://orcid.org/0000-0002-4700-1495)

Department of Global Health, Boston University School of Public Health; Section of Infectious Diseases, Department of Medicine, Boston University School of Medicine, Boston, MA, US

**Godfrey Biemba, MBChB, MSc**  [orcid.org/0000-0002-6064-6722](https://orcid.org/0000-0002-6064-6722)

National Health Research Authority, Pediatric Centre of Excellence, Lusaka, ZM

**Nancy A. Scott, DrPH, MPH**  [orcid.org/0000-0002-4713-4642](https://orcid.org/0000-0002-4713-4642)

Department of Global Health, Boston University School of Public Health, Boston, MA, US

1. **Institute for Health Metrics and Evaluation.** Maternal and neonatal disorders — Level 2 cause. Accessed July 25, 2021. [http://www.healthdata.org/results/gbd\\_summaries/2019/maternal-and-neonatal-disorders-level-2-cause](http://www.healthdata.org/results/gbd_summaries/2019/maternal-and-neonatal-disorders-level-2-cause).
2. **World Health Organization.** *World health statistics 2019: Monitoring health for the SDGs, sustainable development goals.* 2019; 1–120. <https://apps.who.int/iris/handle/10665/324835>
3. **Anto-Acrah M, Cushman J, Sanders M, De Ver Dye T.** A woman's worth: An access framework for integrating emergency medicine with maternal health to reduce the burden of maternal mortality in sub-Saharan Africa. *BMC Emergency Medicine.* 2020; 20(1): 3. DOI: <https://doi.org/10.1186/s12873-020-0300-z>
4. **van Lonkhuijzen L, Stegeman M, Nyirongo R, van Roosmalen J.** Use of maternity waiting home in rural Zambia. *Afr J Reprod Health.* 2003; 7(1): 32–6. DOI: <https://doi.org/10.2307/3583343>
5. **Lori JR, Munro ML, Rominski S,** et al. Maternity waiting homes and traditional midwives in rural Liberia. *Int J Gynaecol Obstet.* 2013; 123(2): 114–8. DOI: <https://doi.org/10.1016/j.ijgo.2013.05.024>
6. **Braat F, Vermeiden T, Getnet G, Schiffer R, van den Akker T, Stekelenburg J.** Comparison of pregnancy outcomes between maternity waiting home users and non-users at hospitals with and without a maternity waiting home: Retrospective cohort study. *Int Health.* 2018; 10(1): 47–53. DOI: <https://doi.org/10.1093/inthealth/ihx056>
7. **Kelly J, Kohls E, Poovan P,** et al. The role of a maternity waiting area (MWA) in reducing maternal mortality and stillbirths in high-risk women in rural Ethiopia. *BJOG.* 2010; 117(11): 1377–83. DOI: <https://doi.org/10.1111/j.1471-0528.2010.02669.x>
8. **Scott NA, Kaiser JL, Ngoma T,** et al. If we build it, will they come? Results of a quasi-experimental study assessing the impact of maternity waiting homes on facility-based childbirth and maternity care in Zambia. *BMJ Glob Health.* 2021; 6(12). DOI: <https://doi.org/10.1136/bmjgh-2021-006385>
9. **van Lonkhuijzen L, Stekelenburg J, van Roosmalen J.** Maternity waiting facilities for improving maternal and neonatal outcome in low-resource countries. *Cochrane Database Syst Rev.* 2012; 10: CD006759. DOI: <https://doi.org/10.1002/14651858.CD006759.pub3>
10. **Ruiz MJ, van Dijk MG, Berdichevsky K, Munguia A, Burks C, Garcia SG.** Barriers to the use of maternity waiting homes in indigenous regions of Guatemala: A study of users' and community members' perceptions. *Cult Health Sex.* 2013; 15(2): 205–18. DOI: <https://doi.org/10.1080/13691058.2012.751128>
11. **Buser JM, Lori JR.** Newborn outcomes and maternity waiting homes in low and middle-income countries: A scoping review. *Matern Child Health J.* 2017; 21(4): 760–769. DOI: <https://doi.org/10.1007/s10995-016-2162-2>
12. **Ghorbanzadeh M, Kim K, Erman Ozguven E, Horner MW.** Spatial accessibility assessment of COVID-19 patients to healthcare facilities: A case study of Florida. *Travel Behav Soc.* 2021; 24: 95–101. DOI: <https://doi.org/10.1016/j.tbs.2021.03.004>
13. **Ordu M, Demir E, Tofallis C.** A comprehensive modelling framework to forecast the demand for all hospital services. *Int J Health Plann Manage.* 2019; 34(2): e1257–e1271. DOI: <https://doi.org/10.1002/hpm.2771>
14. **Iverson KR, Svensson E, Sonderman K,** et al. Decentralization and regionalization of surgical care: A review of evidence for the optimal distribution of surgical services in low- and middle-income countries. *Int J Health Policy Manag.* 2019; 8(9): 521–537. DOI: <https://doi.org/10.15171/ijhpm.2019.43>
15. **Nguyen JM, Six P, Chausselet T, Antonioli D, Lombraill P, Le Beux P.** An objective method for bed capacity planning in a hospital department – a comparison with target ratio methods. *Methods Inf Med.* 2007; 46(4): 399–405. DOI: <https://doi.org/10.1160/ME0385>
16. **Huerta Munoz U, Kallestal C.** Geographical accessibility and spatial coverage modeling of the primary health care network in the Western Province of Rwanda. *Int J Health Geogr.* 2012; 11: 40. DOI: <https://doi.org/10.1186/1476-072X-11-40>
17. **Barclay L, Kornelsen J, Longman J,** et al. Reconceptualising risk: Perceptions of risk in rural and remote maternity service planning. *Midwifery.* 2016; 38: 63–70. DOI: <https://doi.org/10.1016/j.midw.2016.04.007>
18. **Unger H, Thriemer K, Ley B,** et al. The assessment of gestational age: A comparison of different methods from a malaria pregnancy cohort in sub-Saharan Africa. *BMC Pregnancy Childbirth.* 2019; 19(1): 12. DOI: <https://doi.org/10.1186/s12884-018-2128-z>
19. **Kurji J, Gebretsadik LA, Wordofa MA,** et al. Factors associated with maternity waiting home use among women in Jimma Zone, Ethiopia: A multilevel cross-sectional analysis. *BMJ Open.* 2019; 9(8): e028210. DOI: <https://doi.org/10.1136/bmjopen-2018-028210>
20. **Scott NA, Kaiser JL, Vian T,** et al. Impact of maternity waiting homes on facility delivery among remote households in Zambia: Protocol for a quasiexperimental, mixed-methods study. *BMJ Open.* 2018; 8(8): e022224. DOI: <https://doi.org/10.1136/bmjopen-2018-022224>

21. **Henry EG, Ngoma T, Kaiser JL**, et al. Evaluating implementation effectiveness and sustainability of a maternity waiting homes intervention to improve access to safe delivery in rural Zambia: A mixed-methods protocol. *BMC Health Serv Res.* 2020; 20(1): 191. DOI: <https://doi.org/10.1186/s12913-020-4989-x>
22. Zambia 2010 Census of Population and Housing (Central Statistical Office); 2012.
23. **Scott NA, Henry EG, Kaiser JL**, et al. Factors affecting home delivery among women living in remote areas of rural Zambia: A cross-sectional, mixed-methods analysis. *Int J Womens Health.* 2018; 10: 589–601. DOI: <https://doi.org/10.2147/IJWH.S169067>
24. **Lee H, Maffioli EM, Veliz PT**, et al. Role of Savings and Internal Lending Communities (SILCs) in improving household wealth and financial preparedness for birth in rural Zambia. *Health Policy Plan.* 2021; 36(8): 1269–1278. DOI: <https://doi.org/10.1093/heapol/czab049>
25. **Sacks E, Vail D, Austin-Evelyn K**, et al. Factors influencing modes of transport and travel time for obstetric care: A mixed methods study in Zambia and Uganda. *Health Policy Plan.* 2016; 31(3): 293–301. DOI: <https://doi.org/10.1093/heapol/czv057>
26. **Reliefweb.** FEWS NET Zambia Annual Harvest Assessment Report 2004. Accessed Nov 15, 2021. <https://reliefweb.int/sites/reliefweb.int/files/resources/A0B0FD1315C56BDF49256F40001CDB40-fews-zmb-31oct.pdf>.
27. **Scott NA, Vian T, Kaiser JL**, et al. Listening to the community: Using formative research to strengthen maternity waiting homes in Zambia. *PLoS One.* 2018; 13(3): e0194535. DOI: <https://doi.org/10.1371/journal.pone.0194535>
28. Zambia Demographic and Health Survey 2013–14 (Central Statistical Office/Zambia, Ministry of Health/Zambia, & ICF International); 2014.
29. **Hartley JF.** Case studies in organizational research. In: Cassell C, Symon G, eds. *Qualitative Methods in Organizational Research: A Practical Guide.* Sage Publications. 1994; 208–229.
30. **Sikanyiti I.** Expert Group meeting on statistical methodology for delineating cities and rural areas. United Nations; 2019. <https://unstats.un.org/unsd/demographic-social/meetings/2019/newyork-egm-statmeth/docs/s05-01-ZMB.pptx#:~:text=Rural%20Area%3A,Low%20population%20concentration>.
31. **Ricketts T, Johnson-Webb K, Taylor P.** *Definitions of rural: A handbook for health policy makers and researchers. A technical issues paper prepared for the Federal Office of Rural Health Policy Health Resources and services Administration US DHHS;* 1998. <https://www.shepscenter.unc.edu/wp-content/uploads/2014/10/ruralit.pdf>.
32. **AHA Data and Insights.** COVID-19 Bed Occupancy Projection Tool. Accessed Sept 28, 2021. <https://metricvu.aha.org/dashboard/covid-bed-shortage-detection-tool>.
33. **Eurostat Statistics Explained.** Healthcare resource statistics – beds. Accessed Sept 28, 2021. [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Healthcare\\_resource\\_statistics\\_-\\_beds](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Healthcare_resource_statistics_-_beds).
34. **US Health and Human Services.** HHS Protect Public Data Hub: Hospital Utilization. Accessed Sept 28, 2021. <https://protect-public-hhs.gov/pages/hospital-utilization>.
35. **Wild K, Barclay L, Kelly P, Martins N.** The tyranny of distance: Maternity waiting homes and access to birthing facilities in rural Timor-Leste. *Bull World Health Organ.* 2012; 90(2): 97–103. DOI: <https://doi.org/10.2471/BLT.11.088955>
36. **Erickson AK, Abdalla S, Serenska A, Demeke B, Darmstadt GL.** Association between maternity waiting home stay and obstetric outcomes in Ytebon, Ethiopia: A mixed-methods observational cohort study. *BMC Pregnancy Childbirth.* 2021; 21(1): 482. DOI: <https://doi.org/10.1186/s12884-021-03913-3>
37. **Mramba L, Nassir F, Ondieki C, Kimanga D.** Reasons for low utilization of a maternity waiting home in rural Kenya. *International Journal of Gynecology and Obstetrics.* 2009; 108(2): 152–153. DOI: <https://doi.org/10.1016/j.ijgo.2009.08.029>
38. **Lori JR, Perosky JE, Rominski S**, et al. Maternity waiting homes in Liberia: Results of a countrywide multi-sector scale-up. *PLoS One.* 2020; 15(6): e0234785. DOI: <https://doi.org/10.1371/journal.pone.0234785>
39. **Chibuye PS, Bazant ES, Wallon M, Rao N, Fruhauf T.** Experiences with and expectations of maternity waiting homes in Luapula Province, Zambia: A mixed-methods, cross-sectional study with women, community groups and stakeholders. *BMC Pregnancy Childbirth.* 2018; 18(1): 42. DOI: <https://doi.org/10.1186/s12884-017-1649-1>
40. **Phillip PJ, Mullner R, Andes S.** Toward a better understanding of hospital occupancy rates. *Health Care Financ Rev.* 1984; 5(4): 53–61.
41. **Selbana DW, Derese M, Sewmehone Endalew E, Gashaw BT.** A culturally sensitive and supportive maternity care service increases the uptake of maternity waiting homes in Ethiopia. *International Journal of Womens Health.* 2020; 12: 813–821. DOI: <https://doi.org/10.2147/IJWH.S268245>

42. **Dereje S, Yenus H, Amare G, Amare T.** Maternity waiting homes utilization and associated factors among childbearing women in rural settings of Finfinnee special zone, central Ethiopia: A community based cross-sectional study. *PLoS One.* 2022; 17(3): e0265182. DOI: <https://doi.org/10.1371/journal.pone.0265182>
43. **Kebede KM, Mihrete KM.** Factors influencing women's access to the maternity waiting home in rural Southwest Ethiopia: A qualitative exploration. *BMC Pregnancy Childbirth.* 2020; 20(1): 296. DOI: <https://doi.org/10.1186/s12884-020-02988-8>
44. **Bizuwork D.** Maternity waiting homes and safe delivery in Ethiopia. UNICEF. Accessed May 2, 2022. <https://www.unicef.org/ethiopia/stories/maternity-waiting-homes-and-safe-delivery-ethiopia>.
45. **Lefevre M, Van den Heede K, Camberlin C,** et al. Impact of shortened length of stay for delivery on the required bed capacity in maternity services: Results from forecast analysis on administrative data. *BMC Health Serv Res.* 2019; 19(1): 637. DOI: <https://doi.org/10.1186/s12913-019-4500-8>

#### TO CITE THIS ARTICLE:

Vian T, Kaiser JL, Ngoma T, Juntunen A, Mataka KK, Bwalya M, Sakanga VIR, Rockers PC, Hamer DH, Biemba G, Scott NA. Planning for Maternity Waiting Home Bed Capacity: Lessons from Rural Zambia. *Annals of Global Health.* 2022; 88(1): 37, 1–14. DOI: <https://doi.org/10.5334/aogh.3691>

**Submitted:** 04 January 2022

**Accepted:** 05 May 2022

**Published:** 24 May 2022

#### COPYRIGHT:

© 2022 The Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC-BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited. See <http://creativecommons.org/licenses/by/4.0/>.

*Annals of Global Health* is a peer-reviewed open access journal published by Ubiquity Press.