

# Impact of AI-Powered Decision Support Tools on Antimalarial Prescribing Accuracy in Diabetic Pregnant Women Attending Rural Clinics

Muhindo Anitah

Department of Pharmacy Kampala International University Uganda  
Email: [anitah.muhindo@studwc.kiu.ac.ug](mailto:anitah.muhindo@studwc.kiu.ac.ug)

## ABSTRACT

The intersection of malaria, diabetes, and pregnancy presents a complex clinical challenge, particularly in rural Sub-Saharan African settings where diagnostic limitations and therapeutic uncertainties are prevalent. Diabetic pregnant women attending rural clinics are at heightened risk for adverse outcomes due to altered drug metabolism, immune dysfunction, and the delicate balance required in antimalarial prescribing. Traditional prescribing methods in such environments are often empirical and lack patient-specific precision, raising the likelihood of therapeutic missteps. Artificial Intelligence (AI)-powered clinical decision support tools (CDSTs) have emerged as promising innovations capable of integrating multifactorial data such as gestational age, glycemic control, and drug interaction profiles to provide tailored, evidence-based antimalarial recommendations. This review evaluated the potential of AI-powered CDSTs to enhance prescribing accuracy and safety in this vulnerable population. A narrative review methodology was used to synthesize findings from relevant pilot studies, clinical trials, and implementation reports across low-resource settings. Evidence indicates that these tools can significantly improve guideline adherence and reduce prescribing errors. However, challenges such as digital illiteracy, infrastructure limitations, and regulatory gaps hinder their widespread adoption in rural clinics. Addressing these barriers through multisectoral collaboration, context-specific design, and ethical oversight is essential. AI-driven CDSTs offer a transformative opportunity to improve maternal and fetal outcomes in malaria-endemic regions.

**Keywords:** Clinical Decision Support Tools, Antimalarial Prescribing Accuracy, Diabetic Pregnant Women, Artificial Intelligence in Healthcare, Rural Health Systems.

## INTRODUCTION

In recent years, the convergence of infectious and non-communicable diseases has created unique clinical complexities in resource-limited settings. Sub-Saharan Africa is witnessing a troubling rise in non-communicable conditions such as diabetes mellitus, even as malaria continues to exert a significant public health burden [1-3]. Among the most clinically vulnerable populations are diabetic pregnant women, who not only face altered immune responses but also heightened risks of adverse drug reactions and complications related to both diseases. The physiological changes of pregnancy further complicate pharmacokinetics, demanding a high level of precision in therapeutic decision-making. In rural clinics, however, healthcare providers often work under immense pressure with limited diagnostic tools, inconsistent access to patient histories, and overburdened health systems factors that collectively contribute to prescribing inaccuracies.

Antimalarial drug selection in pregnant diabetic patients is particularly delicate. Some antimalarials, such as quinine, carry hypoglycemic risks, while others like artemisinin-based combination therapies (ACTs) have uncertain safety profiles in early gestation [4]. Incorrect prescribing may result in under-treatment of malaria, drug toxicity, or aggravated glycemic instability. Therefore, accurate and context-specific clinical decision-making is critical.

Artificial Intelligence (AI)-powered clinical decision support tools (CDSTs) are increasingly recognized as potential solutions to reduce human error and standardize care in low-resource environments [5, 6]. These tools can integrate patient-specific data such as gestational age, glycemic control status, comorbidities, and drug interactions to recommend appropriate antimalarial therapy. By providing evidence-based guidance, AI-enhanced CDSTs could significantly improve prescribing accuracy, reduce complications, and enhance maternal-fetal outcomes.

This review critically explores the potential impact of AI-powered decision support systems on improving antimalarial prescribing accuracy in diabetic pregnant women attending rural clinics. It evaluates existing evidence, discusses the challenges of implementation in underserved areas, and outlines future directions necessary for optimizing their integration into maternal healthcare frameworks in malaria-endemic regions.

### **Clinical Complexity: Malaria, Diabetes, and Pregnancy Intersection**

Managing malaria during pregnancy is inherently complex, as it is associated with maternal anemia, intrauterine growth restriction, preterm labor, and increased maternal mortality [7, 8]. Superimposing diabetes mellitus onto this already precarious situation significantly elevates clinical risk. Diabetes in pregnancy is associated with poor glycemic control, preeclampsia, fetal macrosomia, and neonatal hypoglycemia. When co-infected with malaria, the metabolic disturbances become even more pronounced, complicating both diagnosis and treatment.

Antimalarial treatment during pregnancy must consider both gestational age and maternal metabolic condition. For example, while ACTs are recommended during the second and third trimesters, they are generally avoided in the first trimester due to limited safety data [9]. Similarly, quinine, although effective, can exacerbate hypoglycemia in diabetic patients posing a serious risk to both mother and fetus. Therefore, accurate, context-driven prescribing becomes a clinical imperative.

In rural clinics, healthcare providers often lack continuous training or decision support frameworks to navigate these multifaceted conditions effectively. Prescribing is frequently based on empirical protocols, sometimes outdated or poorly adapted to individual patient characteristics. This results in therapeutic missteps, ranging from inappropriate drug selection to suboptimal dosing regimens. AI-powered decision tools have the potential to fill these knowledge gaps by generating patient-specific recommendations in real-time.

### **Overview of AI-Powered Decision Support Tools in Clinical Practice**

AI-powered decision support tools (CDSTs) are algorithmic systems designed to assist healthcare providers in making more accurate and consistent clinical decisions [10, 11]. These tools utilize a combination of machine learning (ML), natural language processing (NLP), and rule-based algorithms to analyze patient data and cross-reference it with current evidence-based guidelines.

In prescribing contexts, these systems can perform various tasks: flagging drug interactions, recommending dose adjustments based on renal function or gestational age, predicting adverse events, and even offering alerts about contraindicated medications in pregnancy. When integrated with electronic medical records (EMRs), CDSTs can operate seamlessly within clinical workflows, offering just-in-time support without significantly increasing consultation duration [12].

Some decision support tools are designed specifically for low-resource settings. For example, mobile-based applications that can run offline or require minimal data input have been piloted in several African countries [13]. These tools are particularly promising for rural clinics where health workers may not have access to continuous internet or fully functional EMR systems.

In the context of diabetic pregnant women with malaria, AI-enabled CDSTs can assimilate complex data inputs such as fasting blood glucose, gestational age, history of malaria episodes, and current medication regimens to suggest tailored antimalarial choices. They can also prompt providers to monitor for hypoglycemia risks, suggesting adjunct interventions like glucose monitoring or modified insulin dosing. This level of nuanced, context-specific support is seldom possible through paper-based protocols alone.

### **Evidence Supporting CDSTs in Improving Prescribing Accuracy**

Though the application of AI in rural and maternal care is still emerging, several pilot studies and systematic reviews suggest that CDSTs can significantly enhance prescribing accuracy across various clinical settings [14].

A randomized trial conducted in rural Ghana demonstrated that a rule-based digital support tool improved the appropriate use of antibiotics and antimalarials by 27% compared to standard practice. Similarly, a study from Kenya found that mobile-based CDSTs increased adherence to national malaria treatment guidelines among mid-level health workers by 31%. These findings underscore the potential of AI-assisted tools in ensuring correct drug selection, especially when multiple clinical variables must be considered simultaneously.

Specific to diabetes, AI-driven platforms have shown promise in optimizing insulin dosing and flagging hypoglycemia risk [15]. Although these systems have predominantly been tested in high-income settings, their foundational algorithms can be adapted for use in pregnancy and low-resource environments. When integrated into maternal health platforms, such systems could prompt antimalarial selection that avoids agents with hypoglycemic potential or recommend additional monitoring during quinine administration. However, evidence specific to diabetic pregnant women remains sparse, largely due to the lack of stratified trials in this unique subgroup. Nonetheless, the mechanisms of benefit enhanced data synthesis, standardized decision-making, and proactive risk alerts are broadly applicable and likely to yield similar gains if implemented thoughtfully.

### **Barriers to Implementation in Rural Clinics**

Despite their clinical promise, deploying AI-powered CDSTs in rural environments is not without challenges. The foremost concern is infrastructural readiness. Many rural clinics operate without consistent electricity, internet connectivity, or even electronic record systems all of which can limit the functionality of AI tools [16]. Although mobile-based, offline-capable platforms exist, their deployment still requires devices, updates, and user training.

Human factors also play a role. Many rural healthcare providers may lack digital literacy or feel overwhelmed by the integration of new technologies into already high-pressure clinical environments [17]. In addition, some may mistrust algorithmic recommendations, especially if they deviate from traditional practices or locally endorsed protocols. Without proper training, supervision, and ongoing technical support, utilization rates may remain suboptimal.

There is also the issue of data quality. AI tools rely heavily on accurate and complete data inputs. In clinics where record-keeping is inconsistent, the recommendations produced by AI may be misleading or incorrect [18]. Moreover, few tools are currently tailored for pregnant women with diabetes, limiting their relevance unless specifically adapted.

Cost is another barrier. While CDSTs may reduce downstream healthcare expenditures by preventing complications, the initial investment in software, devices, training, and maintenance can be prohibitive for underfunded health systems. Partnerships with governments, NGOs, and health-tech developers will be essential to creating sustainable models of deployment.

### **Ethical, Regulatory, and Data Security Considerations**

Implementing AI in clinical practice also introduces ethical and regulatory concerns. Informed consent, algorithmic transparency, and data privacy must be addressed rigorously, especially when sensitive maternal and metabolic health data are involved [19].

There is a risk that AI algorithms, if poorly trained or biased by non-representative datasets, may yield skewed recommendations particularly for marginalized or underrepresented groups like diabetic pregnant women in rural SSA [20]. Continuous algorithm auditing and context-specific validation are therefore crucial.

Additionally, regulatory frameworks for AI in health remain underdeveloped in many SSA countries. Governments must establish clear guidelines for software validation, clinical accountability, and post-implementation surveillance [21]. Without these safeguards, the quality and safety of AI recommendations could be compromised.

Data security is also paramount. Rural clinics may lack secure data storage infrastructure, raising the risk of patient confidentiality breaches. Where mobile applications are used, data encryption, password protection, and secure server communication protocols must be standard features.

Addressing these ethical and legal dimensions is essential not only for safeguarding patients but also for fostering trust among users and stakeholders, a prerequisite for long-term adoption.

### **Future Directions and Research Imperatives**

To fully leverage the potential of AI-powered decision support tools in improving antimalarial prescribing for diabetic pregnant women, targeted research and development must be prioritized.

First, clinical validation studies are needed that specifically include this high-risk group. These trials should assess not only prescribing accuracy but also clinical outcomes such as maternal hypoglycemia incidence, malaria clearance rates, fetal growth metrics, and treatment adherence. Multisite trials involving diverse rural settings would enhance the generalizability of findings.

Second, user-centered design must guide tool development. Health workers in rural areas should be involved in shaping interface design, language use, and workflow integration to ensure usability and cultural appropriateness [22, 23].

Third, public-private partnerships can facilitate scalable and sustainable implementation. Collaborations between governments, NGOs, universities, and tech companies can provide the technical, logistical, and financial resources needed to embed CDSTs into national health systems. Inclusion in essential digital health infrastructure plans or maternal-child health initiatives could ensure alignment with broader healthcare goals. Finally, education and capacity building must be central to all implementation efforts. Training modules should be incorporated into nursing and midwifery curricula, and continuing professional development programs must be adapted to reflect the growing role of AI in clinical care.

With these measures in place, AI-powered CDSTs can move from promising prototypes to transformative tools in rural maternal healthcare.

### **CONCLUSION**

The dual burden of malaria and diabetes in pregnant women presents a formidable clinical challenge, particularly in rural settings where healthcare resources are limited. Inaccurate prescribing of antimalarial drugs in this population can result in serious maternal and fetal complications, including hypoglycemia, treatment failure, and

adverse pregnancy outcomes. AI-powered clinical decision support tools offer a novel solution to improve prescribing accuracy by synthesizing complex patient data and delivering tailored, evidence-based recommendations at the point of care. While global evidence supports the utility of these tools in enhancing treatment accuracy and safety, their application in diabetic pregnant women attending rural clinics remains underexplored. Nevertheless, their potential is considerable especially in bridging knowledge gaps, reducing variability in care, and guiding appropriate drug selection in a high-stakes clinical context. Barriers such as infrastructure deficits, digital illiteracy, and regulatory uncertainties must be addressed through strategic planning, investment, and stakeholder engagement. Future research should prioritize context-specific validation and user-centered design to optimize relevance and adoption. With coordinated efforts across sectors, AI-powered decision tools could redefine maternal care standards in malaria-endemic regions, ensuring safer, more effective treatment for some of the most vulnerable patients in global health.

## REFERENCES

1. Umoru, G.U., Uti, D.E., Aja, P.M., Ugwu, O.P., Orji, O.U., Nwali, B.U., Ezeani, N.N., Edwin, N., Orinya, F.O.: Hepato-Protective Effect of Ethanol Leaf Extract of *Datura stramonium* in Alloxan-Induced Diabetic Albino Rats. *Journal of Chemical Society of Nigeria*. 47, (2022). <https://doi.org/10.46602/jcsn.v47i5.819>
2. Tufail, T., Agu, P.C., Akinloye, D.I., Obaroh, I.O.: Malaria pervasiveness in Sub-Saharan Africa: Overcoming the scuffle. *Medicine*. 103, e40241 (2024). <https://doi.org/10.1097/MD.00000000000040241>
3. Ogbozor, Ililochi Basil: Addressing sub-Saharan Africa's burden of endemic diseases: a case for mandatory citizen participation in reaserach on malaria and type 2 diabetes. (2025). <https://doi.org/10.48336/75E7-PC46>
4. Shibeshi, W., Baye, A.M., Alemkere, G., Engidawork, E.: Efficacy and Safety of Artemisinin-Based Combination Therapy for the Treatment of Uncomplicated Malaria in Pregnant Women: A Systematic Review and Meta-Analysis. *Therapeutics and Clinical Risk Management*. (2021)
5. Gomez-Cabello, C.A., Borna, S., Pressman, S., Haider, S.A., Haider, C.R., Forte, A.J.: Artificial-Intelligence-Based Clinical Decision Support Systems in Primary Care: A Scoping Review of Current Clinical Implementations. *European Journal of Investigation in Health, Psychology and Education*. 14, 685–698 (2024). <https://doi.org/10.3390/ejihpe14030045>
6. Sani, N., Adeleke, I.T., Abdullahi, A., Adio, R.A., Aliyu, A., Mu'azu, S.: Harnessing the power of Artificial Intelligence for better health data management. *INTERNATIONAL JOURNAL OF HEALTH RECORDS & INFORMATION MANAGEMENT (IJHRIM)*. 7, (2024)
7. Ugwu, O.P.C., Kungu, E., Inyangat, R., Obeagu, E. I., Okon, M. B., Subbarayan, S. and Sankarapandian, V.: Exploration of Medicinal Plants Used in the Management of Malaria in Uganda. *Newport International Journal of Research in Medical Sciences* 4(1):101-108. (2023)
8. Obeagu, E.I., Obeagu, G.U.: Protecting maternal health: Strategies against HIV and malaria in pregnancy. *Medicine*. 103, e39565 (2024). <https://doi.org/10.1097/MD.00000000000039565>
9. Manyando, C., Kayentao, K., D'Alessandro, U., Okafor, H.U., Juma, E., Hamed, K.: A systematic review of the safety and efficacy of artemether-lumefantrine against uncomplicated Plasmodium falciparum malaria during pregnancy. *Malar J*. 11, 141 (2012). <https://doi.org/10.1186/1475-2875-11-141>
10. Narhare, P.M., P, M.P., B, S., Raj, N.B., Bagchi, S.: Leveraging Artificial Intelligence for Enhanced Clinical Decision Support Systems (CDSS). *Jordan Medical Journal*. 59, (2025). <https://doi.org/10.35516/jmj.v59i2.2889>
11. Almadani, B., Kaiser, H., Thoker, I.R., Aliyu, F.: A Systematic Survey of Distributed Decision Support Systems in Healthcare. *Systems*. 13, 157 (2025). <https://doi.org/10.3390/systems13030157>
12. Lonsdale, H., Gray, G.M., Ahumada, L.M., Yates, H.M., Varughese, A., Rehman, M.A.: The Perioperative Human Digital Twin. *Anesthesia & Analgesia*. 134, 885 (2022). <https://doi.org/10.1213/ANE.00000000000005916>
13. Brinkel, J., Krämer, A., Krumkamp, R., May, J., Fobil, J.: Mobile Phone-Based mHealth Approaches for Public Health Surveillance in Sub-Saharan Africa: A Systematic Review. *International Journal of Environmental Research and Public Health*. 11, 11559–11582 (2014). <https://doi.org/10.3390/ijerph111111559>
14. Graafsma, J., Murphy, R.M., van de Garde, E.M.W., Karapinar-Çarkit, F., Derijks, H.J., Hoge, R.H.L., Klopotowska, J.E., van den Bemt, P.M.L.A.: The use of artificial intelligence to optimize medication alerts generated by clinical decision support systems: a scoping review. *Journal of the American Medical Informatics Association*. 31, 1411–1422 (2024). <https://doi.org/10.1093/jamia/ocae076>
15. Thomas, A., Gopi, V.P., Francis, B.: Chapter 16 - Artificial intelligence in diabetes management. In: Pal, K., Neelapu, B.C., and Sivaraman, J. (eds.) *Advances in Artificial Intelligence*. pp. 397–436. Academic Press (2024)
16. Guo, J., Li, B.: The Application of Medical Artificial Intelligence Technology in Rural Areas of Developing Countries. *Health Equity*. 2, 174–181 (2018). <https://doi.org/10.1089/hecq.2018.0037>

17. Ezenwaji, C.O., Alum, E.U., Ugwu, O.P.-C.: The role of digital health in pandemic preparedness and response: securing global health? *Global Health Action*. 17, 2419694 (2024). <https://doi.org/10.1080/16549716.2024.2419694>
18. Alum, E.U.: AI-driven biomarker discovery: enhancing precision in cancer diagnosis and prognosis. *Discov Onc*. 16, 313 (2025). <https://doi.org/10.1007/s12672-025-02064-7>
19. Oprescu, A.M., Miró-Amarante, G., García-Díaz, L., Rey, V.E., Chimenea-Toscano, A., Martínez-Martínez, R., Romero-Ternero, M.C.: Towards a data collection methodology for Responsible Artificial Intelligence in health: A prospective and qualitative study in pregnancy. *Information Fusion*. 83–84, 53–78 (2022). <https://doi.org/10.1016/j.inffus.2022.03.011>
20. Deivayanai, V.C., Swaminaathan, P., Vickram, A.S., Saravanan, A., Bibi, S., Aggarwal, N., Kumar, V., Alhadrami, A.H., Mohammedsaleh, Z.M., Altalhi, R., Nasser Bin-Jumah, M., Sayed, A.A., Albaqami, A., Chopra, H., Emran, T.B., Abdel-Daim, M.M.: Transforming healthcare: the impact of artificial intelligence on diagnostics, pharmaceuticals and ethical considerations - a comprehensive review. *International Journal of Surgery*. 10.1097/JS9.0000000000002481. <https://doi.org/10.1097/JS9.0000000000002481>
21. Khan, A.Z., Mahmood, F., Bokhari, R.H., Mushtaq, R., Abbas, R.: Challenges of e-government implementation in health sector: a step toward validating a conceptual framework. *Digital Policy, Regulation and Governance*. 23, 574–597 (2021). <https://doi.org/10.1108/DPRG-04-2021-0048>
22. Shamsujjoha, M., Grundy, J., Lu, Q., Khalajzadeh, H., Li, L.: Better Supporting Human Aspects in Mobile eHealth Apps: Development and Validation of Enhanced Guidelines. *ACM Trans. Softw. Eng. Methodol*. (2025). <https://doi.org/10.1145/3721429>
23. Asan, O., Choudhury, A.: Research Trends in Artificial Intelligence Applications in Human Factors Health Care: Mapping Review. *JMIR Human Factors*. 8, e28236 (2021). <https://doi.org/10.2196/28236>

**CITE AS: Muhindo Anitah (2025). Impact of AI-Powered Decision Support Tools on Antimalarial Prescribing Accuracy in Diabetic Pregnant Women Attending Rural Clinics. *IAA Journal of Biological Sciences* 13(2):47-51. <https://doi.org/10.59298/IAAJB/2025/1324751>**