Claire Najjuuko

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PROFILE

I am a fourth-year Ph.D. student in the Computational and Data Sciences Program at McKelvey School of Engineering, Washington University in St. Louis. My work focuses on leveraging advanced computational methods, including machine learning predictive models and large language models, to drive innovation in healthcare delivery and improve public health outcomes. I am particularly interested in uncertainty estimation and trustworthy AI methods that enable safer and more reliable human-AI collaboration in clinical settings. I have developed and evaluated AI applications across global child health, HIV care, substance use recovery, healthcare-associated infection surveillance, postoperative complications, and emergency medical services.

EDUCATION

Washington University in St. Louis — St. Louis, MO
Ph.D. in Data and Computational Sciences — September 2023 – Present
- Dean's Select Ph.D. Fellowship (2023–2029)

Makerere University — Kampala, Uganda
Bachelor of Science in Telecommunications Engineering — August 2016 – August 2021
- Government of Uganda Undergraduate Scholarship (2016–2021)

RESEARCH EXPERIENCE

Graduate Student | Washington University in St. Louis September 2023 – Present

Primary research focuses on applications of machine learning and large language models to improve healthcare delivery and public health outcomes.

Project 1: Machine Learning for HIV Treatment Adherence Monitoring

- **Predicting Poor Adherence to Antiretroviral Therapy (ART)(Published):** Developed and evaluated predictive models to identify adolescents at high risk of suboptimal ART adherence in low-resource settings in Uganda. Applied ensemble methods (Random Forest and XGBoost) to socio-behavioral and psychosocial data from 702 adolescents living with HIV in Uganda, achieving an AUC of 0.71. Models identified key predictors, including depression symptoms, stigma experiences, and caregiver support, to support targeted interventions in resource-limited HIV care programs. Published in *AIDS* (2025). Featured in McKelvey News, (Mar 2025).

Project 2: Machine Learning for Substance Use Risk and Recovery Monitoring

- **Predictors of Problematic Substance Use among Young Adults Living with HIV (Published):** Applied ensemble machine learning methods (Random Forest and XGBoost) to data from 200 young adults living with HIV in low-resourced Ugandan fishing communities to identify key predictors of problematic substance use. Used SHAP values to interpret model predictions, identifying behavioral, psychosocial, and structural risk factors including depression, household instability, and peer influence. Findings inform targeted screening and prevention strategies within HIV care programs. Published in *AIDS and Behavior* (2025).
- **uMATR AI: Multimodal Prediction of Substance Use Recovery Outcomes (Under Review):** Developed a multimodal model that integrates baseline surveys, app engagement metrics, and text messages between clients and coaches in the uMATR digital intervention to enable early prediction of six substance use- and mental health-related outcomes.

Project 3: Hybrid AI Systems for Healthcare-Associated Infection Surveillance

- **LLM + Rules-Based Catheter Associated Infections Surveillance (Published):** Developed and validated a hybrid (LLM + Rules) CAUTI surveillance system combining rule-based NHSN logic with LLM-driven extraction of symptoms from clinical notes. I implemented the Clinical Entity Augmented Retrieval (CLEAR) framework using BIOMed_NER for entity recognition, BioClinicalBERT embeddings for semantic similarity, and GPT-4o for symptom extraction from potential CAUTI cases at Barnes Jewish Hospital (2021–2024). When compared to manual identification by infection preventionists (IPs), our model achieved 90.0% sensitivity and 93.5% specificity, outperforming rules-based approaches (80.4% sensitivity) and standalone LLM methods (88.7% sensitivity), while reducing IP chart review workload by approximately 66%. I implemented the complete data processing pipeline, model development, and evaluation. I am the co-first author of the article published in *Clinical Infectious Diseases* (2026). Also, featured in Division of Infectious Diseases News, (May 2026).

Project 4: Quantifying Uncertainty in Clinical Prediction Models

- **Uncertainty-Aware AI Decision Support for Emergency Medical Services (Manuscript Under Preparation):** Trained and evaluated a multimodal AI model for EMS decision support. The model integrates free-text clinical narratives with longitudinal vital signs to recommend appropriate interventions across 42 protocols and 18 medications. Applied conformal prediction to transform model predictions into calibrated, prediction sets of plausible interventions. Benchmarked multiple imbalance-aware conformal methods to ensure coverage for rare classes. Also developed priority-weighted approaches that increase protection for high-priority interventions without hurting overall performance. Evaluated the potential clinical usefulness of these prediction sets using simulated user models that account for set size, label ordering, and users' expertise. The findings demonstrate that statistical coverage alone does not ensure useful decision support and motivate a prospective study examining how EMS practitioners interpret and use uncertainty information in clinical decision-making.
- **Uncertainty-Aware AI for OR-to-ICU Handoff Decision Support (In Progress):** Developing and evaluating an uncertainty estimation framework for AI-predicted postoperative complications (acute kidney injury, delirium, deep vein thrombosis, pulmonary embolism, and pneumonia) to support OR-to-ICU handoff decision-making. The framework uses a two-stage conformal prediction approach: in the first stage, a conformal predictor generates preliminary prediction sets with a coverage guarantee; in the second stage, confident singleton rule-outs (where the model predicts {Low Risk} alone) are re-evaluated against similar patients in the calibration set. If the rule-out is not well-supported, the prediction is expanded to {Low Risk, High Risk}, signaling uncertainty to the clinician rather than issuing a potentially dangerous confident rule-out. Preliminary results show that this two-stage approach reduces false negative rates across all five complication models. A within-subjects user study will evaluate which uncertainty communication format best supports handoff decisions.

Project 5: Maternal and Child Health Service Utilization (Published)

- Analyzed patterns of maternal and child health services utilization and associated socioeconomic disparities across sub-Saharan Africa using machine learning approaches and Demographic and Health Survey data from 352,363 mother-child pairs across 35 countries. Identified critical service utilization patterns linked to child mortality outcomes. Published in *Nature Communications* (2025). Featured in McKelvey News, August 2025.

Undergraduate Research Assistant | Makerere University July 2020 – June 2021

- **Rural Broadband Connectivity Model:** Piloted a rural broadband connectivity model funded by Research and Innovations Fund Uganda (PI: Eng. Dr. Dorothy Okello). Conducted technical feasibility studies for 5G and TV white space technologies in rural Ugandan communities. Co-authored three papers on rural connectivity solutions and codesigning approaches.

Undergraduate Student | Makerere University August 2019 – December 2020

- **Undergraduate Final Year Project:** Applied the random forest model to optimize sleep mode in dense cellular networks, implementing energy-efficient algorithms to reduce power consumption while maintaining optimal network performance.

PUBLICATIONS

Peer-Reviewed Journal Articles

1. Nordman J*, **Najjuuko C***, Jeschke N, Snyders RE, Vazquez Guillamet MC, Shapiro J, Leone C, Dethloff M, Babcock H, Reich P, Whalen K, Zhang L, Luong L, Lu C, Atkinson A, Marschall J, Sung A. The Best of Both Worlds: How Combining a Large Language Model and a Rule-Based Algorithm Makes CAUTI Surveillance More Efficient. *Clinical Infectious Diseases*. 2026; ciag301. *Co-first authors. https://doi.org/10.1093/cid/ciag301
2. Ssentumbwe V, Matovu F, Namatovu P, **Najjuuko C**, Kizito S, Nabayinda J, Nartey P, Namuwonge F, Nabunya P, Lu C, Mutumba M, Ssewamala FM. Using Machine Learning to Predict Depression among Adolescents Living with HIV in Uganda. *Global Social Welfare*. 2026 Mar 21. https://doi.org/10.1007/s40609-026-00456-3
3. **Najjuuko C**, Brathwaite R, Mutumba M, Childress S, Nannono S, Namatovu P, Lu C, Ssewamala FM. Identifying Predictors of Problematic Substance Use Among Youth Living with HIV in Uganda: A Machine Learning Approach. *AIDS and Behavior*. 2025 Sep 18:1-2. https://doi.org/10.1007/s10461-025-04840-6
4. **Najjuuko C**, Xu Z, Kizito S, Lu C, Ssewamala FM. Patterns of maternal and child health services utilization and associated socioeconomic disparities in sub-Saharan Africa. *Nature Communications*. 2025; 16:7840. https://doi.org/10.1038/s41467-025-61350-8
5. **Najjuuko C**, Brathwaite R, Xu Z, Kizito S, Lu C, Ssewamala FM. Using machine learning to predict poor adherence to antiretroviral therapy among adolescents living with HIV in low resource settings. *AIDS*. 2022 Apr 20:10-97. https://doi.org/10.1097/QAD.0000000000004163
6. Tutlam NT, Nabunya P, Kizito S, Migadde H, Ssentumbwe V, Namuwonge F, **Najjuuko C**, Mugisha J, Sensoy Bahar O, Mwebembezi A, Ssewamala FM. The Impact of Group-Based Interventions on Emotional and Behavioral Difficulties among Adolescents Living with HIV: The Suubi4Stigma Cluster Randomized Controlled Trial. *Journal of Child and Family Studies*. 2025 Feb 12:1-9. https://doi.org/10.1007/s10826-025-03015-0
7. Nabunya P, Ssewamala FM, Kizito S, Mugisha J, Brathwaite R, Neilands TB, Migadde H, Namuwonge F, Ssentumbwe V, **Najjuuko C**, Bahar OS. Preliminary Impact of Group-Based Interventions on Stigma, Mental Health, and Treatment Adherence Among Adolescents Living with Human Immunodeficiency Virus in Uganda. *The Journal of Pediatrics*. 2024 Jun 1;269:113983. https://doi.org/10.1016/j.jpeds.2024.113983
8. Nabunya P, Migadde H, Namuwonge F, Mugisha J, Kirabo W, Ssentumbwe V, **Najjuuko C**, Raymond A, Bahar OS, Mwebembezi A, McKay MM. Feasibility and acceptability of Group-based stigma reduction interventions for adolescents living with HIV and their caregivers: the Suubi4Stigma Randomized Clinical Trial (2020-2022). *AIDS and Behavior*. 2024 Feb 3:1-2. https://doi.org/10.1007/s10461-024-04284-4

9. Kizito S, Namuwonge F, Nabayinda J, Nalwanga D, **Najjuuko C**, Nabunya P, Atwebembere R, Namuyaba OI, Mukasa M, Ssewamala FM. A Cluster-Randomized Controlled Trial of an Economic Strengthening Intervention to Enhance Antiretroviral Therapy Adherence among Adolescents Living with HIV. *AIDS and Behavior*. 2024 May;28(5):1570-80. https://doi.org/10.1007/s10461-024-04268-4
10. Nabunya P, Cavazos-Rehg P, Mugisha J, Kasson E, Namuyaba OI, **Najjuuko C**, Nsubuga E, Filiatreau LM, Mwebembezi A, Ssewamala FM. An mHealth Intervention to Address Depression and Improve Antiretroviral Therapy Adherence Among Youths Living With HIV in Uganda: Protocol for a Pilot Randomized Controlled Trial. *JMIR Research Protocols*. 2024 Mar 8;13(1):e54635. https://doi.org/10.2196/54635
11. White PJ, Okello D, Casey BP, **Najjuuko C**, Lukanga R. Co-designing with engineers for community engagement in rural Uganda. *Design Science*. 2023 Jan;9:e12. https://doi.org/10.1017/dsj.2023.10

Conference Papers

12. Wang S, Xu Z, **Najjuuko C**, Alba C, Lu C. CURA: Clinical Uncertainty Risk Alignment for Language Model-Based Risk Prediction. In *Proceedings of the 63rd Annual Meeting of the Association for Computational Linguistics (ACL 2026)*. Association for Computational Linguistics; 2026. https://arxiv.org/abs/2604.14651
13. **Najjuuko C**, Ayebare GK, Lukanga R, Mugume E, Okello D. A survey of 5G for rural broadband connectivity. *In 2021 IST-Africa Conference (IST-Africa)* 2021 May 10 (pp. 1-10). IEEE. https://ieeexplore.ieee.org/abstract/document/9576832
14. Lukanga R, Ayebare GK, **Najjuuko C**, Mugume E, Okello D. Leveraging TV white spaces for rural broadband connectivity. *In 2021 IST-Africa Conference (IST-Africa)* 2021 May 10 (pp. 1-8). IEEE. https://ieeexplore.ieee.org/document/9576962

Manuscripts Under Review

15. **Najjuuko C**, Kabarambi A, Ssentumbwe V, Nartey P, Nabunya P, Sensoy Bahar O, McKay MM, Ssewamala FM. The Long-term Impact of a Family Intervention on Symptoms of Attention-Deficit/Hyperactivity Disorder (ADHD) Among Primary School-Going Children in Uganda, 2016-2022. *Under review*. 2026.
16. **Najjuuko C**, Szlyk H, Li X, Kasson E, Lu C*, Cavazos-Rehg P*. Predicting One-Month Substance Use and Mental Health Recovery Outcomes in a Real-World Digital Health Intervention for Underserved Communities. *Under review*. 2026.

PRESENTATIONS

1. Nordman J*, **Najjuuko C***, Jeschke N, Snyders RE, Vazquez Guillamet MC, Shapiro J, Leone C, Dethloff M, Babcock H, Reich P, Whalen K, Zhang L, Luong L, Lu C, Atkinson A, Marschall J, Sung A. The Best of Both Worlds: How Combining a Large Language Model and a Rule-Based Algorithm Makes CAUTI Surveillance More Efficient. *Poster presentation at the 2026 I^2DB Annual Symposium Innovation*, Washington University in St. Louis, St. Louis, MO, April 2026. Honorable Mention: Research Excellence.
2. **Najjuuko C**, Brathwaite R, Xu Z, Kizito S, Lu C, Ssewamala FM. Using machine learning to predict poor adherence to antiretroviral therapy among adolescents living with HIV in low resource settings. *Project presentation at Mini-Conference on AI and Poverty: Advancing Health, Education, and Equity*, NYU Silver School of Social Work, New York, NY, November 2025.
3. **Najjuuko C**, Brathwaite R, Mutumba M, Childress S, Nannono S, Namatovu P, Lu C, Ssewamala FM. Identification of illicit substance use predictors in young adults living

with HIV in low resource communities in Uganda: A machine learning approach. *Poster presentation at Society for Prevention Research (SPR) 33rd Annual Meeting*, Seattle, WA, May 2025. https://spr.confex.com/spr/spr2025/meetingapp.cgi/Paper/34697

4. **Najjuuko C**, Brathwaite R, Xu Z, Kizito S, Lu C, Ssewamala FM. Using machine learning to predict poor adherence to antiretroviral therapy among adolescents living with HIV in low resource settings. *Poster presentation at Global Health at WashU: Focus on Impact*, Washington University in St. Louis, April 2025.

WORK EXPERIENCE

Data Manager | International Center for Child Health and Development Masaka, Uganda
Report to: Principal Investigator September 2021 – July 2023

Study Coordination:

- **mHealth Study:** Coordinated mobile health intervention protocol development to address depressive symptoms among youth living with HIV in Uganda (Funded by McDonnell Scholars Academy; PIs: Proscovia Nabunya, Patricia Cavazos-Rehg).

Data Management (managed data for 6 concurrent longitudinal studies):

- **M-Suubi (R01MH126892):** Multi-level integrated intervention to reduce HIV stigma impact on treatment outcomes among adolescents living with HIV
- **Bridges R2 (R01HD070727-02):** Longitudinal impacts of economic intervention on HIV risk prevention and care continuum outcomes among orphaned youth transitioning to young adulthood
- **Suubi4Stronger Families (R01MH128905):** Addressing child behavioral health by strengthening financial stability and parenting among families in Uganda
- **Suubi4Stigma (R21MH121141):** Addressing HIV-associated stigma among adolescents
- **Suubi+Adherence R2 (R01HD074949):** Longitudinal HIV treatment adherence among youth living with HIV transitioning into young adulthood
- **Kyaterekera (R01MH116768):** 5-year longitudinal study addressing sexual risk-taking behaviors among vulnerable women in Uganda

TECHNICAL SKILLS

Programming and Scripting Languages: Python, R, SQL, LaTeX

Machine Learning & Deep Learning: scikit-learn, TensorFlow, PyTorch

Natural Language Processing & LLMs: HuggingFace Transformers, spaCy, OpenAI API, Groq API, LangChain, RAG pipelines

Agentic AI: LangGraph, LangSmith

Development Tools & Environments: Jupyter, Git/GitHub, Docker, VSCode

Statistical Software: STATA, SPSS

CONFERENCES, WORKSHOPS, AND SEMINARS

- Mini-Conference on AI and Poverty: Advancing Health, Education, and Equity, NYU Silver School of Social Work, November 2025
- Society for Prevention Research (SPR) 33rd Annual Meeting, Seattle, WA, May 2025
- Global Health at WashU: Focus on Impact, Washington University in St. Louis, 2025
- AI for Health Symposium, Washington University in St. Louis, 2024
- AI for Health Symposium, Washington University in St. Louis, 2023
- Forum on Child and Adolescent Global Health Research and Capacity Building, 2023
- Forum on Child and Adolescent Global Health Research and Capacity Building, 2022
- The 6th National Conference on Communications, 2020
- Uganda Institution of Professional Engineers Students Workshop, 2020
- Global Grand Challenges Summit, Kampala Satellite Event, 2019

- Wireless Communication Workshop organized by IEEE Communication Society, 2018

ADDITIONAL TRAINING

- Researcher Resilience Training Program, Fellow 2024
- Researcher Resilience Training Program, Fellow 2023

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