inSupplyHealth
CO-CREATING INNOVATIONS FOR HEALTH

Patrick J McGovern FOUNDATION

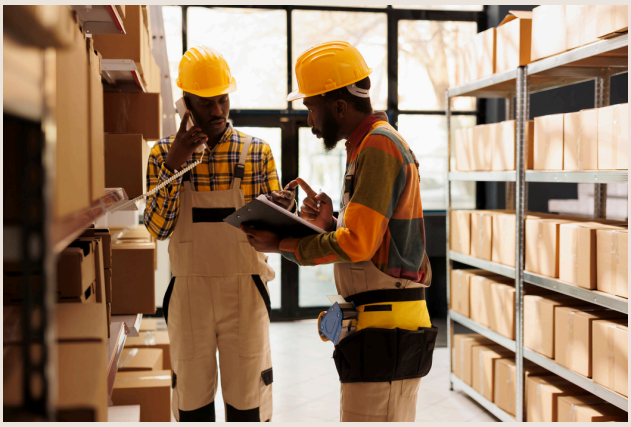
Using AI to Enhance Forecasting in Kenya & Tanzania

BRIEF 2022-2024

BACKGROUND AND CONTEXT

Healthcare commodities quantification teams across many countries in Sub-Saharan Africa struggle to accurately forecast the quantities of health commodities required at public and private sector service delivery sites.

Inaccurate forecasts contribute to inefficiencies in financing and procurement, leading to stock-outs, shortages, overstocks, and increased supply chain costs. In Kenya and Tanzania, despite well-established national policies and guidance documents, the forecasting and supply planning processes face significant challenges due to a heavy reliance on manual processes and tools.



Thus, data extraction and processing (e.g. organization, cleaning etc.), trend analysis and use of fit-for-purpose forecast methods are time-consuming, burdensome, require advanced skills and multiple data sources. These barriers hinder public health programs from improving their data quality and methodologies, causing delays and inconsistencies in quantification outputs. This leads to low confidence in forecast accuracy, resulting in these outputs not being consistently used for resource allocation or procurement planning.

Advancements in healthcare and digital infrastructure in both countries offer an opportunity to employ advanced methods for forecasting and supply planning. Developing a roadmap for integrating Artificial Intelligence (AI) tools into existing systems is crucial. This process requires building stakeholder trust in AI outputs and ensuring AI-enhanced decision-making is well understood and sustainably integrated into existing systems.

Introduction to the Project

Forecasting in global health is both an art and a science and has always relied on imperfect, incomplete data.

Traditionally, forecasts are done at national levels in aggregate. Open-source tools often only exist for vertical programs and do not automate all steps in the process.

The "Using AI to Improve Quantification in Kenya and Tanzania" project, funded by the Patrick McGovern Foundation, commenced in October 2022. Its primary aim was to harness AI technology to enhance quantification and forecasting abilities in Kenya and Tanzania. inSupply Health in partnership with Afya Intelligence and governments sought to augment efficiency, data quality, and decision-making processes at both central and subnational levels through the integration of automation and advanced analytics.

> This is amongst the well contextualized solutions to our local challenges developed by our local experts. The future of our BUQ process is promising.

Dennis Kapinga,
Regional Laboratory Technologist,
Coast Region-Tanzania

Project Objectives

- Identification and validation of specific AI use cases to improve forecasting and quantification.
- Design and development of tailored AI solutions for these identified cases, coupled with the acquisition of necessary data inputs.
- Pilot test, refine, and implement these AI solutions and data processes across national and subnational levels.
- Documentation and articulation of the benefits and opportunities presented by AI in decision-making contexts.
- Identification of both enablers and barriers to the integration of AI into existing workflows.
- Comprehensive documentation of the impacts, insights, and lessons learned throughout the project's implementation phase.
- Evaluation of potential scalability of solutions and assessment of country readiness for widespread adoption and institutional integration.
- Future prospecting for enhancements and exploration of new areas where AI could be effectively leveraged.

Introduction to the Project

Project Guiding Principles

- Using imperfect data is better than no data.
- Data quality improves when data is used routinely.
- Technology is adopted, scaled, and sustained when it solves a real problem defined by users in a way that works for them.

Project Approach

- We unpacked AI as a new concept and spent time building the confidence of users in the process.
- Involved users and decision-makers from the start, replicating their existing approach in a fully transparent process.
- Our tools/outputs include human-in-the-loop touchpoints for users to review and approve data at all steps.

> Quantification of health products and technologies in Kenya has for a long time been a laborious process due to the manual nature of collation and analysis of data. Over the last one year, I have had the opportunity to participate in supporting counties and strategic health programs to undertake the quantification process in a novel way by use of Artificial intelligence. Courtesy of inSupply Health, I have personally witnessed the positive impacts of Artificial Intelligence and technology utilization in enhancing the generation of forecast outputs both nationally and at the county level. This marks a significant shift and as a member of the DHPT team, I anticipate further collaborations with inSupply Health to embrace these methodology, that will ultimately contribute to well informed decisions for budget allocation.

Dr. Sospeter Gitonga,
Division of Health Products and Technologies

Achievements and Impact

The project's impact has been substantial. Custom, automated data processing tools were developed to support data extraction, processing, and aggregation, significantly enhancing work efficiency. Before the project, Kenya's national programs conducted annual quantifications with periodic reviews focused on national-level data. Data for family planning (FP) commodities were manually collected from the Kenya Health Information System (KHIS), which is the Kenyan version of DHIS2, for all 47 counties, using only 12 months of data, visually checking for outliers, and estimating needs using average monthly consumption. Counties undertook quantification when funding was available, which was costly and time-consuming, requiring data collection for 1700-2500 commodities across sampled health facilities and manual aggregation, cleaning, and analysis of data.

1

We automated data cleaning for multiple factors, including non-reporting facilities and outliers, employing statistical algorithms to improve work efficiency and effectiveness.

Previously, FP and maternal, newborn, and child health (MNCH) forecasts required manual data cleaning. Now, the tools created by inSupply Health for both FP and MNCH use 42 months (3.5 years) of historical data from over 10,000 facilities. These tools standardize data formatting, eliminate duplicate records, detect outliers, fill in missing values, and adjust for non-reporting facilities using predefined calculation methods agreed upon by stakeholders.

This automation has significantly reduced data processing and management time from weeks to less than 30 minutes. inSupply developed a County tool and database that aggregates data from all sampled facilities, classifies products by facility, and estimates consumption for each product by facility type for forecasting purposes. The tool significantly reduced data processing and management time by weeks, eased the workload for health workers, and allowed data to be used for forecasting within weeks instead of months.

REDUCED

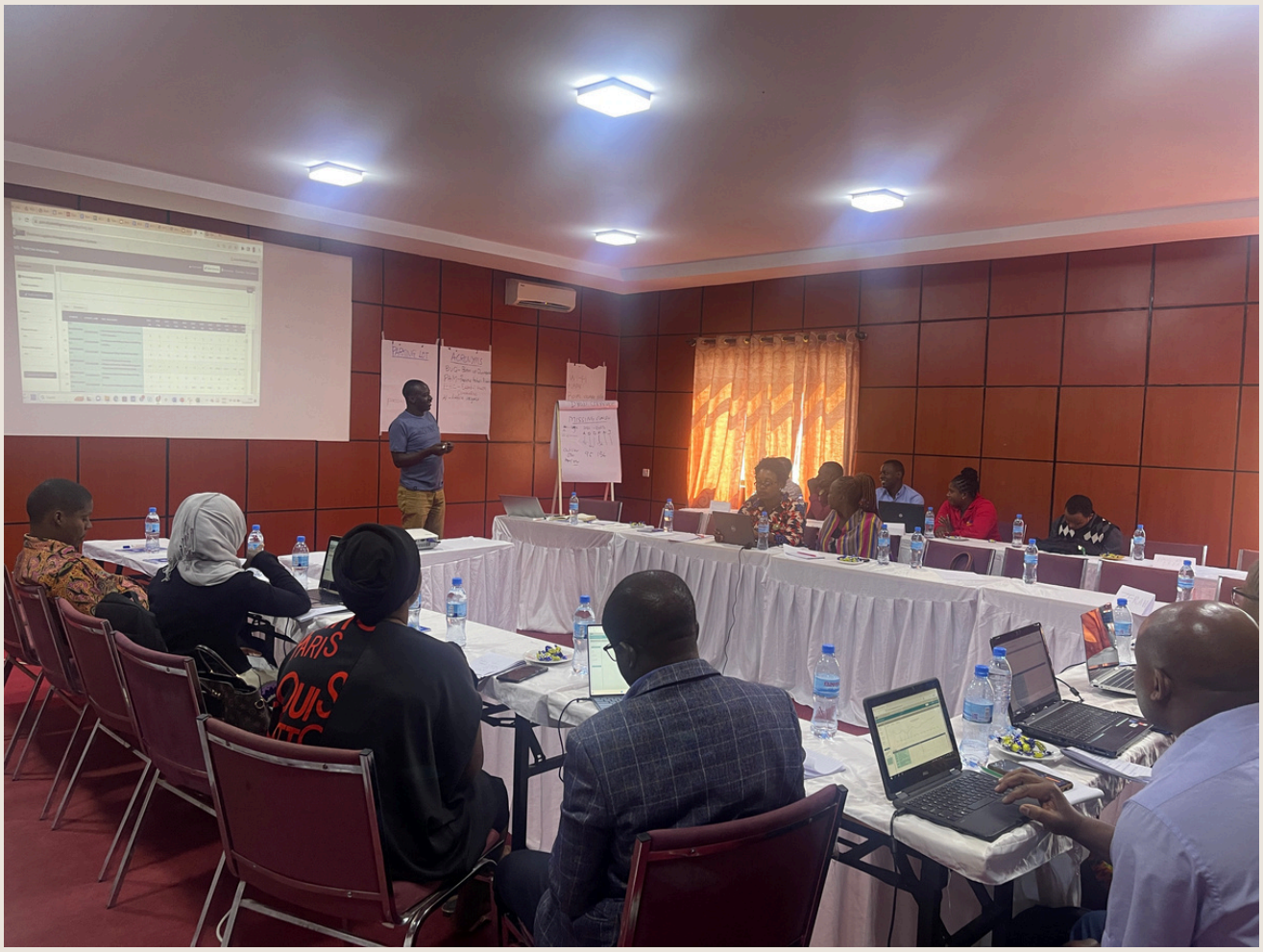
DATA PROCESSING & MANAGEMENT TIME

FROM WEEKS TO

LESS THAN 30 MIN

Achievements and Impact

In Tanzania, the Predictive Analytic Model (PAM) for Bottom-Up Quantification (BUQ) tool developed by inSupply Health replicates electronic logistic management information system's (eLMIS) incorporates data cleaning, including adjustments for missing data and outliers using trends from two years of historical data. This streamlined process reduces the burden on health workers, ensuring that facilities can submit more accurate and refined forecasts. The BUQ tool enables facilities to review cleaned, adjusted data and finalize submissions within a single day, with visualizations and tables depicting pre- and post-clean data for every product, facilitating easy validation and verification of forecast quantities. This is a transformation from a situation where facilities need to manually review their forecasts for each item which ranges from 200 -1000 items depending on the facility (dispensary, hospital etc) which is tedious thus facilities generally do not undertake a thorough review and push data to the district with significant quality issues, with the same reason these forecasts pass the district and regional to the national level which leads to procurement that is based on non-accurate forecasts.



Tanzania: AI predictive analytics training for BUQ in Dodoma.

Achievements and Impact

2

The project also enhanced work effectiveness through more robust and optimized forecast approaches powered by AI.

For both FP and MNCH forecasts, we enhanced the methodology using a machine learning (ML) algorithm (Prophet) to analyze complex, non-stationary time series data. Prophet breaks cleaned input data into three parts: overall trend, regular patterns (e.g., yearly cycles), and special events (e.g., holidays). It then learns from past data and provides future predictions. The FP tool hosts this model, which analyzes historical data, identifying trends, seasonal patterns, and special events, and provides easy-to-understand forecasts visualized in graphs and tables. For MNCH, the tool exists as code functionality that can generate comprehensive forecast reports without user interactions.

In Tanzania, the BUQ tool further enhanced the robustness of the forecast by using ARIMA and Exponential Smoothing ML algorithms to analyze historical data, identifying trends, seasonal patterns, and special events, and using that information to predict quantities for the forecast. By building in visuals of past historical trends, the tool helps facilities understand why the tool's forecast differs from the eLMIS forecast, ensuring they are confident in reviewing and approving the enhanced forecasts. To gain stakeholder buy-in at all levels, the tool also provides for forecast aggregation at district, region, and national levels, where approvals and decisions are made, and supports ongoing forecast accuracy monitoring.

3

Additionally, the visual analytics we developed facilitated data use through analysis, interpretation, and decision-making.

In Kenya, health workers used saved time during workshops to build assumptions from technical experts and develop analytics to inform decisions. User-friendly visuals enabled teams to easily understand the data and support decisions such as including seasonality in forecasts and selecting the type of forecast to use. In Tanzania, facility-level visualizations provided insights for over 500 products, highlighting data completeness and top-consumed products, and facilitating direct comparison of complementary or similar items.

inSupply Health developed four open-source tools (FP, MNCH, County, BUQ) custom-built for each program, designed to integrate seamlessly with existing health information systems. The principles behind all tools are the same, but each tool was customized to work for the specific context, data system, program, and commodity group. Integration is complete in Kenya with KHIS and planned in Tanzania with eLMIS.

42

months (3.5 years) of historical data

from over

10,000

facilities

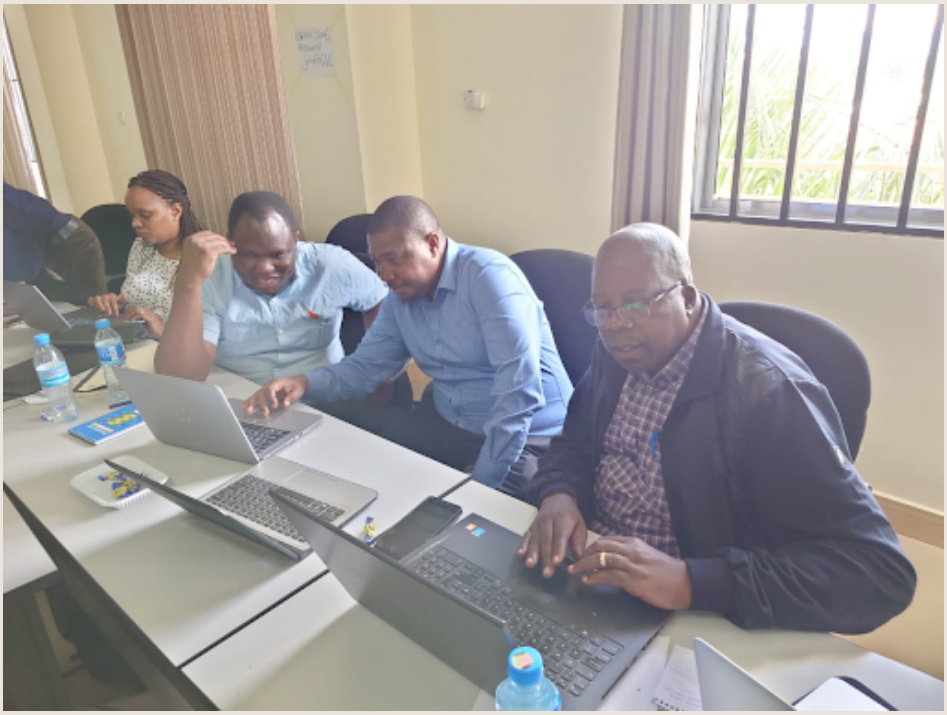
Remaining Work and Future Plans

The next phase of the project aims to build on previous work and learnings to introduce efficiencies, advance robustness and effectiveness, and enhance evidence-based decisions in key upstream and downstream supply chain functions.

The timeline for upcoming phases includes mapping current processes, developing and validating tools, and documenting impacts and lessons learned. This iterative and evolving development process will ensure relevance and buy-in from stakeholders throughout.

Objectives include

- enhancing existing forecasting tools with expanded data sources and advanced predictive capabilities
- integrating finalized tools within MOH systems
- developing supply planning tools for the Medical Stores Department (MSD) in Tanzania and counties in Kenya, and
- exploring how AI can enhance efficiency and accuracy in ordering and resupply processes.



The inSupply team collaborating with healthcare workers in Tanzania during a Bottom-Up Quantification workshop.

Key Lessons and Conclusion

- Effective stakeholder engagement from the outset is crucial. Co-developing solutions with the MOHs fosters trust, ownership, and sustainability, particularly when their specific challenges in the quantification process are acknowledged. Extensive engagement with stakeholders at various levels ensured the tools were user-centric and easily integrated into existing systems. This led to the sustainable and effective integration of the tools in national processes and systems, with MOHs in both countries recognizing their value in enhancing forecasting and quantification. A stepwise process, placing the MOH in the driving seat for adopting new tools, methods, and processes, paved the way for broader adoption, showcasing the potential of these tools as scalable and adaptable solutions in healthcare forecasting.
- Recognizing the value of data naturally elevates concerns about data security, especially as data imperfections become more evident with manual usage.
- Emphasizing the user interface and experience of AI tools can significantly improve the user journey and demystify AI technology.
- Moreover, AI can add substantial value to imperfect data; when the people and process aspects of AI adoption are handled correctly, enthusiasm and excitement grow exponentially as users realize the enhanced efficiency and effectiveness in their work.

The project demonstrated the significant potential of AI in improving healthcare commodities quantification and forecasting processes in Kenya and Tanzania. By integrating AI tools into existing systems, we achieved substantial improvements in efficiency, accuracy, and decision-making. Our approach of continuous stakeholder engagement and tailored solutions ensured the successful adoption and sustainability of these tools. Future plans aim to build on this success, further enhancing forecasting capabilities and exploring new areas where AI can add value.

> Quantification exercise used to take many weeks to complete, Isiolo county took a record 4 days to extrapolate and come up with final outputs of the quantification through technology innovations by insupply. Kudos inSupply!

Dr. Claver Kimathi,
Isiolo County pharmacist and Chairperson of county pharmacists in Kenya

Acknowledgements

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