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Pre-implementation Process Mapping to inform the Design of a Multicomponent Hypertension Screening Intervention Integrated into HIV Differentiated Service Delivery at Community Pharmacies in Kampala, Uganda

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Abstract

Background

The scale-up of antiretroviral therapy has substantially improved life expectancy among people living with HIV, while concurrently increasing the risk of hypertension and other non-communicable diseases (NCDs). In Uganda, differentiated service delivery (DSD) models increasingly use community pharmacies for ART refills; however, these models of care lack systematic screening for NCDs. We applied pre-implementation process mapping to identify workflow gaps, implementation opportunities, and required adaptations to integrate blood pressure screening into pharmacy-based HIV differentiated service delivery.

Methods

We conducted a pre-implementation process-mapping study at the Mulago Immune Suppression Syndrome (ISS) Clinic and two affiliated community pharmacies in Kampala between June and July 2024. Guided by the PRECEDE framework and Lean Six Sigma principles, we integrated data from 12 key-informant interviews with clinic and pharmacy staff and eight structured workflow observation sessions. Preliminary process maps were iteratively refined and validated through stakeholder consultations to produce a consolidated workflow map to inform integration of BP screening into pharmacy-based HIV differentiated service delivery.

Results

Across sites, eight preliminary process maps demonstrated highly consistent ART refill workflows. The final consolidated map identified feasible integration points for BP screening, most notably during the waiting and counselling stages, without disrupting service flow. Stakeholders broadly endorsed integration but emphasised the need for staff training, validated BP equipment, and standardised referral protocols. Patients valued the convenience of combined HIV–NCD services, although concerns about additional costs and potential increase in waiting times were raised. System-level gaps, such as informal referral pathways and weak documentation practices, were identified as potential threats to effective follow-up for clients with elevated BP

Conclusions

Pre-implementation process mapping demonstrated that integrating BP screening into pharmacy-based DSD HIV care is feasible and acceptable, with minimal disruptions to existing ART refill workflows. The findings highlight specific workflow integration points and system requirements, including staff capacity building, validated equipment and standardised referral and documentation. Strengthening these elements could enable community pharmacies to serve as effective platforms for integrated HIV–NCD care in urban Uganda.

Background

The scale-up of antiretroviral therapy (ART) has substantially improved life expectancy among people living with HIV (PLHIV), while concurrently increasing the risk of hypertension and other non-communicable diseases (NCDs)[1]. In sub-Saharan Africa, the dual epidemics of HIV and NCDs are straining health systems already challenged by declining donor funding and limited resources. Integrated service delivery approaches are therefore urgently needed to sustain treatment outcomes while addressing emerging comorbidities[2].

In 2017, Uganda adopted differentiated service delivery models to enhance the efficiency and accessibility of HIV care[3], including extending medication refills and follow-up services beyond health facilities. One of such innovative and client-centred models involves community pharmacies, which dispense ART to stable patients and currently serve 10% of the national HIV population, as well as up to 60% of the community-based HIV population. While these pharmacies have demonstrated convenience, facilitated high retention, and patient satisfaction, they currently provide limited NCD-related services. The absence of

hypertension screening at these community points represents a missed opportunity for early detection and prevention among PLHIV.

Documenting the design and adaptation of interventions that incorporate NCD care into DSD models is crucial for informing replication and scaling up. Process mapping offers a structured, visual method for understanding and redesigning healthcare workflows. It allows the documentation of existing processes, identifies inefficiencies, and locates natural integration points for new services. In the context of HIV-NCD integration, process mapping helps clarify how new screening or referral tasks fit within the existing DSD structures without overburdening staff or compromising ART refill efficiency[4].

Guided by the Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation (PRECEDE) framework, we conducted process-mapping activities to inform the design of a planned multicomponent intervention to integrate hypertension screening into community retail pharmacies linked to the Mulago Immune Suppression Syndrome (ISS) Clinic, a large outpatient HIV clinic in Kampala. This manuscript focuses on the development and application of a process map to guide intervention preparation; the implementation of the intervention is not included.

Methodology

Study Design and Theoretical Frameworks

Using qualitative methods and the Lean Six Sigma process-mapping approach(LSS)[5], we evaluated the pre-intervention state of care coordination for PLHIV receiving care at community retail pharmacies attached to the Mulago ISS Clinic. We modified the LSS process mapping technique to gather process data through an iterative, multi-step process during a pre-implementation assessment. The LSS is recommended to minimise waste and improve process efficiency and productivity. The process mapping was carried out to support the integration of hypertension screening into community pharmacies involved in the HIV differentiated service delivery (DSD) model.

Study setting

This process and information flow mapping were conducted at the Mulago ISS Clinic and the affiliated community pharmacies. Mulago ISS Clinic is the largest HIV clinic in Uganda, providing comprehensive HIV services to over 16,500 PLHIV. The clinic is located within Mulago National Referral and Teaching Hospital in Kampala, Uganda's Capital City. HIV-related clinical activities include HIV testing and counselling (HTC) and management of ART. The clinic also implements Differentiated Service Delivery (DSD) models, including: Fast-track drug delivery refill (FTDR), Facility-Based individual and group management (FBIM and FBG), the Community Client Led ART Delivery (CCLAD), and Community Drug Distribution Points, including the retail pharmacies.

Mulago ISS clinic is owned and operated by the Makerere University Joint AIDS Program (MJAP). At this clinic, HIV services are provided by doctors, nurses, clinical officers, HIV counsellors, laboratory technicians, pharmacy technicians, and record officers, as well as PLHIV expert clients. The Mulago ISS clinic currently collaborates with two private community pharmacies as part of the CRPDDPs model, located in Kawempe and Nakulabye on the outskirts of the capital city. These community private pharmacies have a memorandum of understanding with MJAP to offer ART drug refills to PLHIV. The cost per client per visit is Ushs. 2000 (~ 0.6USD), this cost is met by the PEPFAR HIV implementing partners and not the patients [6]. Each pharmacy caters to a clientele of slightly over 2800 clients. These have their visits spanning the whole year, with an average of about 1400 clients per quarter. Both pharmacies were included in the study

Data Collection

In the first step, we developed preliminary process maps using data from key informant interviews with staff from the Mulago ISS Clinic, affiliated community pharmacies, and people living with HIV (PLHIV). These interviews documented the reported patient flow within the community pharmacy ART refill model and captured stakeholder perspectives on integrating blood pressure (BP) screening into routine practice. The interview guide was informed by the Predisposing, Reinforcing, and Enabling Constructs in

Educational Diagnosis and Evaluation (PRECEDE) [7] framework (Table 1) and comprised seven open-ended questions aligned with the study objectives. Face validity was assessed through review by two experts in HIV differentiated service delivery and hypertension care.

We purposively selected seven ISS Clinic staff (two doctors, one clinical officer, one nurse, one expert client, the clinic manager, and the CRPDDP focal person) and five pharmacy staff under MJAP supervision (two medicine dispensers, two pharmacists, and one manager). Interviews, conducted on-site, lasted about 30 minutes, were audio-recorded, and transcribed verbatim. Data were analysed through iterative team-based content analysis, and the resulting process steps and integration perspectives were synthesised into a preliminary process map using Microsoft Visio flowchart and diagramming software[8].

The second step involved site visits to observe the workflow at the two pharmacies. This stage helped refine the process maps and also detect discrepancies between stakeholder interviews and real practices. Using triangulation across interviews and observations increased credibility by allowing cross-verification of findings and highlighting differences between reported and observed workflows. Initial visits to participating pharmacies also helped establish rapport.

The third step involved drafting preliminary process maps by the study team after synthesising interview and observation data. These maps outlined the stepwise flow of ART refill patients, potential integration points for BP screening, and potential decision nodes (e.g., elevated BP prompting referral). Stakeholder feedback sessions with pharmacy staff, ISS Clinic personnel, and expert clients were then used to refine the maps. These discussions verified the accuracy of process steps, clarified roles and responsibilities, and improved representation of communication channels. The iterative and participatory nature of this approach reflected principles of co-production[9], a recognised best practice in implementation science.

The fourth step involved the development of final process maps using Microsoft Visio flowchart and diagramming software and incorporated swim lanes (to distinguish actors), decision nodes (to represent elevated BP thresholds), and feedback loops (to capture referral outcomes and follow-up). The process maps were annotated to highlight timing of steps, resource requirements, and risks. Stakeholder consultations identified key bottlenecks. Validation sessions with pharmacy staff and ISS Clinic providers confirmed the accuracy of the maps and ensured that identified bottlenecks were contextually grounded.

A multidisciplinary team consisting of three experienced qualitative analysts, an internal medicine postgraduate student and researcher, and a biostatistician conducted the data collection and analysis. This iterative process enhanced the credibility and transferability of the findings, consistent with qualitative research standards of rigour. Approval for the study was obtained from the Makerere University School of Medicine Research and Ethics Committee, number Mak-SOMREC-2024-949.

Table 1
Semi-Structured Key Informant Interview Questions Mapped to Constructs of the PRECEDE Framework

KII Question	Factor identified
What do you know about the CRPDDP model?	Predisposing, Reinforcing
Can you describe your role in the enrolment and management of people on the CRPDDPs model?	Predisposing, Reinforcing
What is your view on conducting screening for hypertension at the CRPDDPs?	Predisposing, Enabling, and Reinforcing
What challenges do you foresee in hypertension screening at the CRPDDPs?	Enabling
Can you think of any factors that could support hypertension screening at the CRPDDPs?	Enabling, Reinforcing
How at ease would you be with the idea of having patients screened for hypertension at community pharmacies?	Reinforcing

CRPDDP: Community Retail Pharmacy Drug Distribution, KII: Key Informant Interview, PRECEDE: Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation

Results

Data were collected between June and July 2024. Twelve participants (N = 12) were interviewed, comprising staff from the Mulago ISS Clinic and its two affiliated community pharmacies. Participants, mostly female (n = 7), represented diverse roles across the HIV care continuum, including two doctors, one nurse, one expert client (PLHIV peer), the clinic manager, and the CRPDDP focal person. Pharmacy staff included two medicine dispensers, two pharmacists, and one pharmacy manager.

In addition, eight workflow observation sessions were conducted (four per pharmacy), each lasting approximately one hour and scheduled at different times of the day to capture variation in service delivery patterns. In total, eight hours of direct observation were completed (Table 2). The sessions documented the existing ART refill workflow prior to integrating blood pressure (BP) screening, allowing identification of natural entry points for BP measurement and potential bottlenecks in patient flow, documentation, and referral communication.

Table 2. Description of participants in the Process Mapping Sessions.

Setting	Roles Represented	Number of participants/sessions	Description
Mulago ISS Clinic	Two doctors, one clinical officer, one nurse, one expert client (PLHIV peer), one clinic manager, one CRPDDP focal person	n=7	Clinical and coordination staff involved in ART delivery and referral linkage
Community Pharmacies	Two dispensers, two pharmacists, one pharmacy manager	n=5	Frontline and supervisory pharmacy staff managing ART refills under MJAP supervision
Workflow observations		8 sessions (4 per pharmacy, 1 hour each)	Direct observation of ART refill workflows conducted at different times of day to capture variation

Abbreviations: ART: Antiretroviral Therapy, CRPDDP: Community Retail Pharmacy Drug Distribution Point, MJAP: Makerere University Joint AIDS Program.

Consolidated Process map

Eight preliminary process maps were developed from interview and observation data, capturing workflows observed at different times of day and across sites. Despite minor variations in staffing and patient flow, the sequence of service steps was largely consistent. These maps were subsequently merged into a single consolidated process map (**Figure 1**). The final map illustrates the baseline ART refill workflow and identifies feasible points for integrating blood pressure (BP) screening without disrupting existing routines, particularly during the waiting period before dispensing and during counselling.

The mapping exercise also revealed gaps in existing referral pathways. At the time of data collection, referrals from the community pharmacies to the Mulago ISS Clinic were made only when a client presented with another ailment requiring medical review. These channels were largely informal, inconsistently documented, and seldom followed up on. Although the ART refill process itself was predictable and stable, the absence of structured referral and feedback mechanisms could hinder the future integration of BP screening, since elevated readings would similarly require timely and reliable linkage to care

Operational Findings

Across both pharmacies, direct observation revealed a largely uniform ART refill process, characterised by a stable sequence of activities and clearly defined staff roles. Although minor fluctuations in client volume were noted, the overall flow of services remained consistent across observation periods. Waiting and counselling phases emerged as natural points of flexibility within the workflow, where brief additional activities could be introduced. Taken together, these observations indicate that the existing ART refill model has the structural capacity to accommodate carefully integrated tasks without undermining core dispensing functions.

Qualitative Themes

Interviews and stakeholder discussions enriched the observational findings by revealing how providers, patients, and the broader health system might respond to integrating blood pressure (BP) screening within community pharmacy, based HIV care.

Pharmacy staff generally welcomed the idea, describing BP screening as a logical extension of their preventive care role and a return to earlier clinical practices. As one participant noted:

"*That is a very good idea because that is a gap that is not happening, and remember when they were still accessing care from here, we would take their BPs on every visit but it's not happening in the CRPDDPs. So, it is a very, very good intervention to be effected*." (**KII_Participant_4**)

However, participants emphasised that successful implementation would depend on structured training and clear referral protocols to support decision-making and ensure confidence among pharmacy staff:

"*You definitely need training for the staff who are going to participate if we want to use the existing systems. But there is also another option of having an employee put at the pharmacy yes, an employee dedicated specifically to screening. Depending on what is put in place, there is need for capacity building if we are to use the staff*." (**KII_Participant_6**)

Providers also identified the lack of appropriate equipment as a critical barrier:

"*Basically, we need a BP machine. If it is digital, of course it comes with the cost of changing batteries over and over*." (**KII_Participant_8**)

Patients expressed enthusiasm about the potential for "receiving two services in one place." They viewed integrated screening as convenient and efficient, echoing their previous experiences at the Mulago ISS Clinic, where BP checks were routine. They appreciated the possibility of early detection of hypertension alongside ART refills.

Nevertheless, both providers and patients anticipated challenges such as additional costs from referral visits and potential delays in pharmacy workflows. These concerns underscored the importance of maintaining efficiency, with standard operating procedures and workflow clarity essential to prevent extended waiting times or disrupted ART refills.

At the system level, discussions repeatedly highlighted weaknesses in documentation and referral communication between pharmacies and the ISS Clinic. One provider explained:

"*Consistency, knowing who screens, who supervises them, how results are interpreted, when to refer, and how to confirm that the person has been brought back to the mother clinic—is all important, because there are now specific codes for those NCDs*." (**KII_Participant_9**)

Another added:

"*Communication between the pharmacy teams and the main clinic for people with elevated BPs is important for patient safety and continuity of care. The two systems should communicate, if they could merge the Electronic Medical Records, that would be very good*." (**KII_Participant_1**)

Existing registers were not designed to capture NCD information. Without standardised referral pathways or reliable feedback loops with the ISS Clinic, patients identified with elevated BP risked being lost to follow-up, undermining the fundamental purpose of screening when referral for care cannot be completed.

From Mapping to Intervention Design

Taken together, these findings directly informed the refinement of an intervention package adopted from the Resolve to Save Lives (RTSL) toolkit on integrating HIV and Hypertension management. Recognising provider capacity gaps led to the development of a targeted training package, while the absence of equipment justified the provision of validated BP monitors and anthropometric tools. Patient concerns about cost and waiting time guided the creation of standard operating procedures to

streamline screening and referral without adding delays. System-level weaknesses in documentation and communication prompted the establishment of standardised referral pathways linking community pharmacies with the ISS Clinic.

Through iterative development and stakeholder validation, the process maps incorporated perspectives from both providers and patients. This participatory approach enhanced the accuracy of the final maps, strengthened ownership, and reinforced the feasibility and acceptability of integrating hypertension screening into the pharmacy-based ART refill model

Discussion

This study sought to use process mapping to assess the feasibility of integrating hypertension screening into community pharmacy–based ART refill models in Kampala. We found that existing ART refill workflows were highly standardised and time-efficient, with clear opportunities to incorporate blood pressure measurement without disrupting core dispensing activities. However, the process mapping revealed critical system-level gaps, including unclear staff roles for blood pressure screening, limited access to functional equipment, inconsistent documentation practices, and weak referral pathways for clients with elevated blood pressure. These findings directly informed the design of a multicomponent intervention comprising targeted staff training, provision of blood pressure equipment, standard operating procedures, and standardised referral pathways.

It is essential to note that current applications of LSS in the healthcare industry focus on optimising existing clinical and administrative processes by identifying and eliminating process inefficiencies and optimising workflows. We modified the LSS approach, and specifically, the process mapping tool, for a different purpose, to introduce a new role into an existing process while optimising program uptake and ensuring minimal workflow disruptions. Our findings are consistent with experiences from other settings in which process mapping has been used to guide intervention adaptation. For example, McCreight et al. used process mapping to inform the implementation of the Transitions Nurse Program in the United States. Veterans Health Administration[10], demonstrating how mapping revealed both overlapping roles and critical gaps in care coordination that shaped program adaptation.

Similar lessons have been observed in African contexts. In Rwanda, mapping of pre-hospital emergency services showed delays and communication breakdowns, leading to targeted workflow and referral improvements before system changes were introduced[11]. In Uganda, process maps of HIV service delivery helped providers reflect on inefficiencies and resource use, demonstrating the utility of mapping for visualising and redesigning routine services[12].

. In contrast to Studies in hospitals and clinics that often emphasise congestion and spatial limitations as key barriers to adding new services[13], we found that community pharmacies, with their streamlined refill focus and smaller patient volumes spread out in the day, offered sufficient workflow flexibility for additional screening tasks. The primary challenge in this setting was weak referral and documentation systems, which required the design of standardised pathways and communication loops with the ISS Clinic, highlighting the unique strengths of pharmacy-based DSD models for integration, while also identifying system-level vulnerabilities that must be addressed for sustainability.

Our work adds to the literature on patient and provider perspectives in HIV–NCD integration. Consistent with findings from other African studies on “one-stop” models of care[14], patients valued the convenience of combining ART refills with hypertension screening. However, their concerns about additional costs and potential delays underscored the importance of maintaining efficiency through streamlined standard operating procedures. Providers’ emphasis on training and equipment also mirrors findings from pharmacy-based HIV interventions elsewhere in the region[15], reinforcing that capacity-building and resource provision are prerequisites for sustainable implementation.

Finally, the participatory nature of the mapping process deserves emphasis. Involving clinic staff, pharmacy personnel, and patients in the development and validation of process maps enhanced accuracy and built ownership. Similar to other mapping-based interventions in Africa and LMICs, where co-production improved feasibility and local fit[16], our approach strengthened the likelihood that the proposed intervention would be both acceptable and sustainable within routine service delivery.

Implications for Policy and Practice

Our findings have direct implications for policymakers and implementers working to expand differentiated HIV service delivery models in Africa. First, they demonstrate that pharmacies, already integral to Uganda's HIV DSD strategy, can serve as effective platforms for integrated NCD care if adequately supported with requisite training and equipment. Second, the participatory approach reinforces the value of engaging frontline actors in shaping interventions, which increases feasibility and sustainability.

Strengths and Limitations

A major strength of this study is its rigorous, multi-source approach. By triangulating interviews, observations, and stakeholder validation, we ensured that the maps captured both reported and actual workflows, reducing the risk of bias. The participatory approach further strengthened credibility and buy-in.

However, several limitations should be noted. First, this was a pre-implementation assessment; no actual hypertension screening was conducted, and thus the maps depict potential rather than realised integration. Second, the study was limited to two pharmacies linked to the ISS Clinic, which may constrain generalizability to other pharmacy models in Uganda or beyond. Finally, while qualitative insights enriched the maps, some participants may have described "ideal" workflows rather than actual practices, a challenge also noted in other mapping studies. Nonetheless, by anchoring observations in real-time workflow sessions and cross-checking with multiple stakeholders, we sought to minimise this limitation.

Conclusion

Pre-implementation process mapping demonstrated that integrating BP screening into pharmacy-based DSD HIV care is feasible and acceptable, with minimal disruptions to existing ART refill workflows. The findings highlight specific workflow integration points and system requirements, including staff capacity building, validated equipment and standardised referral and documentation. Strengthening these elements could enable community pharmacies to serve as effective platforms for integrated HIV–NCD care in urban Uganda.

Abbreviations

AIDS	Acquired Immunodeficiency Syndrome
ART	Antiretroviral Therapy
CRPDDP	Community Retail Pharmacy Drug Distribution Points
CCLAD	Community Client-Led ART Delivery
DSD	Differentiated Service Delivery
EMR	Electronic Medical Records
FTDR	Fast Track Drug Refills
FBIM	Facility-Based Individual Management
FBGs	Facility-Based Groups
HIV	Human Immunodeficiency Virus
HTC	HIV Testing and Counselling
LSS	Lean Six Sigma process-mapping
LMIC	Low- and Middle-Income Countries
MJAP	Makerere University Joint AIDS Program

NCDs	Non-Communicable Diseases
PEPFAR	U.S. President`s Emergency Plan for AIDS Relief.
PLHIV	People Living with HIV.
PRECEDE	Predisposing, Reinforcing, and Enabling Constructs in Education Diagnosis and Evaluation
SSA	Sub-Saharan Africa
UAC	Uganda AIDS Commission
UNAIDS	The Joint United Nations Programme on HIV/AIDS
WHO	World Health Organisation

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with good clinical practice (GCP/ICH) guidelines. Approval for the study was obtained from the Makerere University School of Medicine Research and Ethics Committee, number Mak-SOMREC-2024-949. Permission to access the HIV medical records of participants receiving care under the CRPDDPs was requested from the Mulago ISS Clinic administration. Written informed consent was secured from each participant, outlining the study's purpose, benefits, estimated interview duration, and ensuring confidentiality. Privacy was maintained by conducting interviews in a private room.

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

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Authors` contributions

DJM: conceptualisation, Investigation, Methodology, analysis, writing, review and editing

MM: Methodology, analysis, review and editing

IDK: review and editing

JN: Conceptualisation, review and editing

IS: review and editing

FCS: conceptualisation, funding acquisition, methodology, review and editing

MRK: conceptualisation, funding acquisition, methodology, review and editing

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Author`s information

At the time of the study, the corresponding author was a postgraduate student in the department of Internal Medicine at Makerere University College of Health Sciences, Makerere University, Uganda.

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Figures

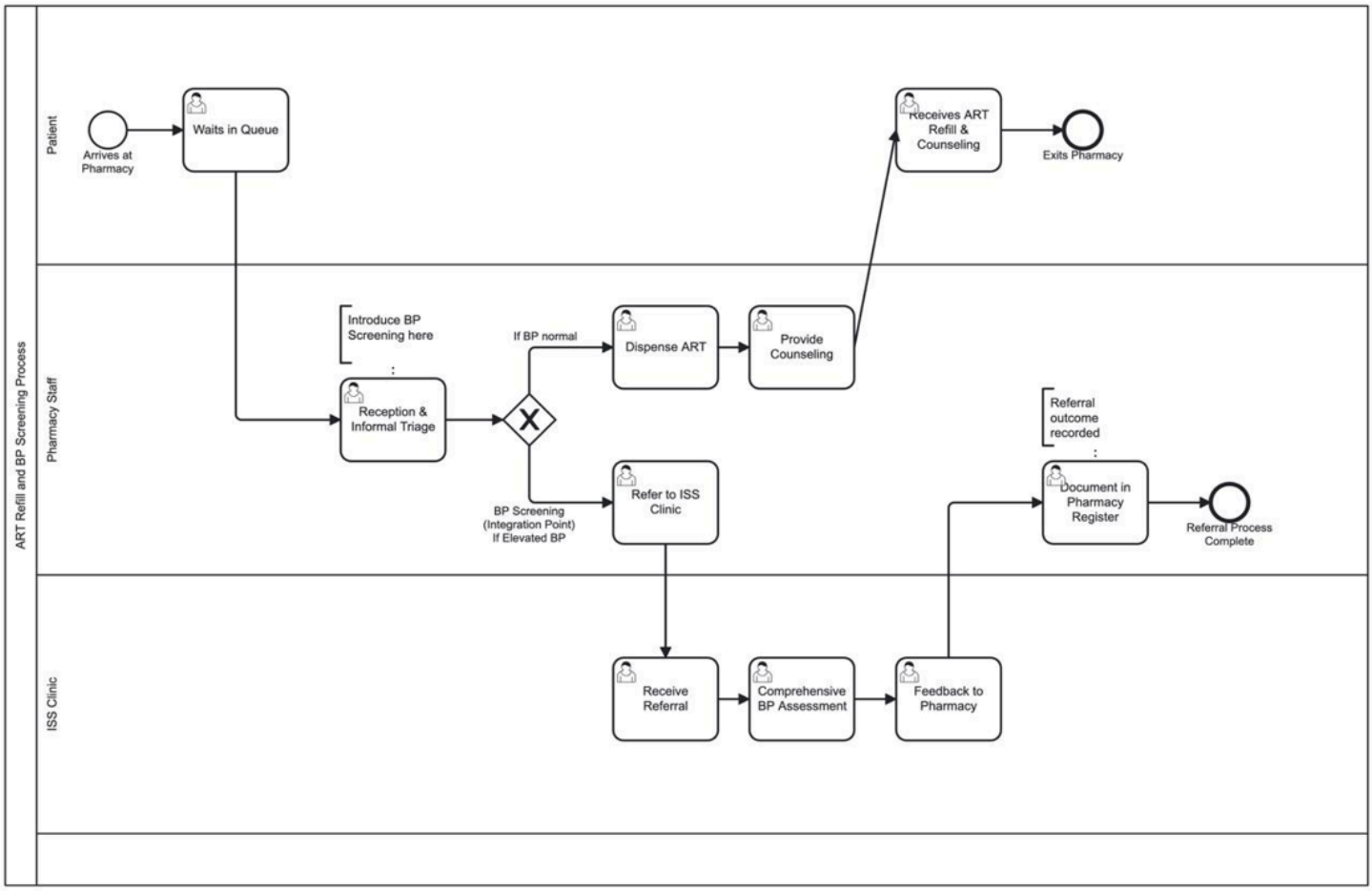


Figure 1

Consolidated process map of the baseline ART refill workflow at community pharmacies with proposed integration point for blood pressure screening

The map depicts the routine ART refill process at community pharmacies before integration of BP screening. Swim lanes distinguish the roles of patients, pharmacy staff, and the ISS Clinic. The diamond node marks the proposed BP screening insertion point, with a referral pathway to the ISS Clinic for elevated readings. A feedback loop ensures referral outcomes are communicated back to the pharmacy