



WORKSHOP REPORT

Retain6 Risk Triaging Workshop Online, April 18, 2023

Retain6 Project

<https://sites.bu.edu/ambit/the-retain6-project/>

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CONTENTS

I. BACKGROUND AND RATIONALE	3
II. WORKSHOP OBJECTIVES.....	3
III. SUMMARY OF SESSIONS.....	4
1. Literature review and case studies	4
2. Overview of risk triaging for ART retention	4
3. PREDICT development and implementation	6
IV. DISCUSSION	7
General comments about and concerns with risk triaging.....	7
Timing and implementation of risk triaging	8
PREDICT tool feedback	9
How would we define success?	10
V. NEXT STEPS	10
VI. REFERENCES	11
VII. ANNEXES	12

I. BACKGROUND AND RATIONALE

One of the challenges facing treatment programs for HIV and other chronic conditions in sub-Saharan Africa is how to target interventions to maximize long-term retention in care [1–4]. Ideally, interventions aimed at improving adherence and retention should be offered to patients at higher risk of loss from care or poor adherence, while not adding to the burden of care or utilizing resources unnecessarily for lower risk patients who do not require additional attention. How to identify high risk patients before they experience negative outcomes, however, remains a puzzle.

Retain6, a project supported by the Bill & Melinda Gates Foundation and conducted by Boston University, the Health Economics and Epidemiology Research Office (HE²RO), and CHAI-Zambia, is exploring patterns of disengagement from care during the early HIV treatment period (first 6 months after ART initiation) in sub-Saharan Africa (SSA) and seeking new models of service delivery to improve outcomes during this period. One of Retain6’s goals is to develop an approach for identifying patients most vulnerable to disengagement during this period, to allow better targeting of interventions. Traditionally, most efforts to target interventions aimed at improving retention in care or reducing interruptions in treatment have identified the most vulnerable patients on the basis of observed behavior. Patients who are observed to miss clinical visits or medication refills are identified after the event and targeted for tracing, counselling, home-based care, and other services that may help them resume scheduled care [5–10].

An alternative to this post-hoc strategy for identifying vulnerable patients is “risk triaging,” or the process of identifying patients before they experience an interruption in care. Previous risk scores developed to improve HIV outcomes (e.g.[11,12]) have not been adopted for widespread use in SSA. A triage tool designed specifically for HIV care providers in primary healthcare clinics, where most HIV treatment is provided, that relies solely on indicators already collected or very easily added to routine data collection in standard of care, is not dependent on access to resources such as networked computers or smart phones, and has very clear and specific follow-up actions may overcome barriers to adoption in SSA.

To review what is known about risk triaging at the primary healthcare level in SSA, and seek expert input on the triaging tool being developed for the early HIV treatment period, Retain6 conducted a three-hour, online technical workshop in April 2023. The workshop agenda, list of participants, and presentations are appended to this report. Below we summarize the objectives, sessions, and outcomes of the workshop and propose next steps for Retain6.

II. WORKSHOP OBJECTIVES

The primary aim of the workshop was to address the question, “Can risk triaging feasibly be incorporated into routine ART delivery in South Africa and other countries using existing resources? We defined risk triaging as the process of identifying and stratifying a healthcare client’s risks of future negative outcomes. We noted that:

- Risk triaging ≠ diagnosis. It is a screening tool to prioritize individuals for further intervention (diagnosis or preventative actions). For example, in South Africa and Zambia the WHO TB symptom screen is a risk triaging tool; Xpert MTB is a diagnostic tool.

- Risk triaging ≠ intervention. First one identifies risks, then matches risk profiles to interventions. Risk triaging is a means to an end (better-targeted interventions), not an end in itself, and it has little value if undertaken without followup. (The *process* of evaluating risk, using a risk triaging tool, however, may serve as an intervention.)
- We are interested in the characteristics of ART patients, their communities, healthcare facilities, and/or service delivery that predict future disengagement from HIV treatment.

The specific objectives of the workshop were to:

- Review past experience with risk triaging and risk scoring at the primary care level in SSA
- Examine the conceptual basis for and approaches to risk triaging
- Present and critique the PREDICT tool for ART risk triaging
- Discuss opportunities for improving risk triaging for initiating and re-initiating ART patients.

III. SUMMARY OF SESSIONS

As shown in the report agenda (Appendix 1), the workshop was organized into three presentation sessions, followed by a discussion.

1. Literature review and case studies

In the first substantive session, we presented the results of a systematic literature review of risk triaging at the primary healthcare level in SSA. This session asked the question, “What informative examples do we have of risk triaging applied to priority health conditions in a primary healthcare setting?” From the results of the review, we presented three case studies relevant to Retain6’s objectives.

Case study 1: Applying a risk scoring tool to inform care intensification and reduce mortality[11]

Case study 2: Applying a risk scoring tool to predict HIV acquisition for prevention targeting[13–15]

Case study 3: A rare success at scale: the WHO TB symptom screen[16]

ADULT TB SYMPTOM SCREENING				
Symptoms				
Temperature	BP	Pulse	Weight	Height
Cough ≥2 weeks OR of any duration if HIV-positive			Yes	No
Persistent fever >2 weeks			Yes	No
Unexplained weight loss >1.5 kg in a month			Yes	No
Drenching night sweats >2 weeks			Yes	No
MEDICAL HISTORY				
Close contact of a person with infectious TB		Yes	No	Unknown
Type of index patient		DS TB		MDR/XDR TB
Diabetes		Yes	No	Unknown
HIV status		Positive	Negative	Unknown

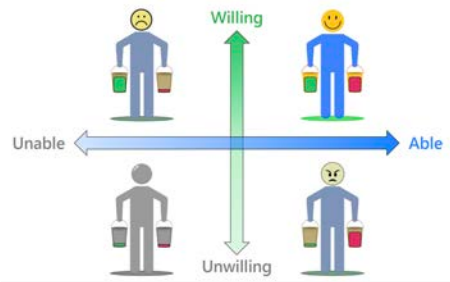
The literature review is currently being prepared as a journal manuscript and is expected to be available as a pre-print by end May 2023.

2. Overview of risk triaging for ART retention

The second session introduced and explained a number of concepts relevant to understanding how risk triaging might work for ART retention. These included:

- For a patient to achieve successful HIV treatment outcomes, they must be both able and willing to engage in treatment in a sustained way. Willing and able individuals are at low risk of interruption to treatment (ITT) and likely require little intervention to successfully continue their care journey. Unwilling or unable groups are both at higher risk of interrupting treatment but likely require differ services (interventions) and options based on their degree and type of risk. With enough data and the right methods, we can identify correlations and associations between patient characteristics and risks of ITT.

Willing and able – two overlapping scales



- The risk of ITT is dynamic over time. A patient may be at high risk immediately after initiating ART, then settle into a routine and be at low risk for several years, before becoming high risk again due to a life transition, such as a new job. Observing changes in risk over time can help providers intervene before ITT occurs.

		Current Visit Risk Group		
		Green (low risk)	Yellow (Mod risk)	Red (high risk)
Previous Visit Risk Group	G	85% (84 - 86%) n= 2658; IIT 7%	15% (11 - 17%) n= 436; IIT 16%	1% (0 - 5%) n= 37; IIT 35%
	Y		62% (60 - 64%) n= 1630; IIT 16%	10% (7 - 14%) n= 267; IIT 26%
	R			37% (31 - 43%) n= 231; IIT 32%

- By matching demographic and behavioral characteristics, we can identify drivers of risk using routinely collected or easy-to-obtain data and create risk profiles that accurately predict future ITT.



Group by demographics AND behaviour	n	Pop%	IIT%	Risk of ITT vs ADULT FEMALES			
				Abs	OR	RR	95% CI
ADULT FEMALES	4 920	57%	13.3%	-	1	1.00	-
ABYM RETURNING INTERRUPTER	23	0.3%	34.8%	0.214	3.44	2.59	1.473 - 4.555
ABYM LATE TWICE	21	0.2%	23.8%	0.104	2.01	1.77	0.822 - 3.823
AGYW LATE TWICE	61	0.7%	23.0%	0.096	1.92	1.71	1.074 - 2.719
AGYW RETURNING INTERRUPTER	50	0.6%	22.0%	0.086	1.82	1.64	0.967 - 2.776
ADULT FEMALES RETURNING INTERRUPTER	651	7.7%	18.9%	0.055	1.62	1.50	1.256 - 1.795
ADULT MALES RETURNING INTERRUPTER	399	4.7%	19.3%	0.059	1.54	1.44	1.161 - 1.779
ADULT FEMALES LATE TWICE	563	6.6%	17.6%	0.042	1.44	1.37	1.124 - 1.657
ADULT MALES LATE TWICE	354	4.2%	18.1%	0.047	1.42	1.35	1.066 - 1.700
AGYW PROMPT LOYAL	119	1.4%	16.8%	0.034	1.3	1.25	0.834 - 1.878
ADULT MALES PROMPT LOYAL	548	6.5%	15.9%	0.025	1.22	1.18	0.962 - 1.452
ADULT FEMALES PROMPT LOYAL	895	10.5%	15.2%	0.018	1.2	1.17	0.979 - 1.388
ABYM PROMPT LOYAL	31	0.4%	9.7%	-0.037	0.69	0.72	0.245 - 2.118

3. PREDICT development and implementation

- The third session demonstrated the potential value of the PREDICT tool at the individual patient, facility, and program levels. [17–19]
- Piloting of the PREDICT tool in Mpumalanga found that nearly all healthcare workers agreed with the risk score produced by the scorecard.
- Healthcare workers intuitively matched risk scores to interventions.
- Anecdotally, healthcare workers reported that the scorecard improved their interactions with clients.

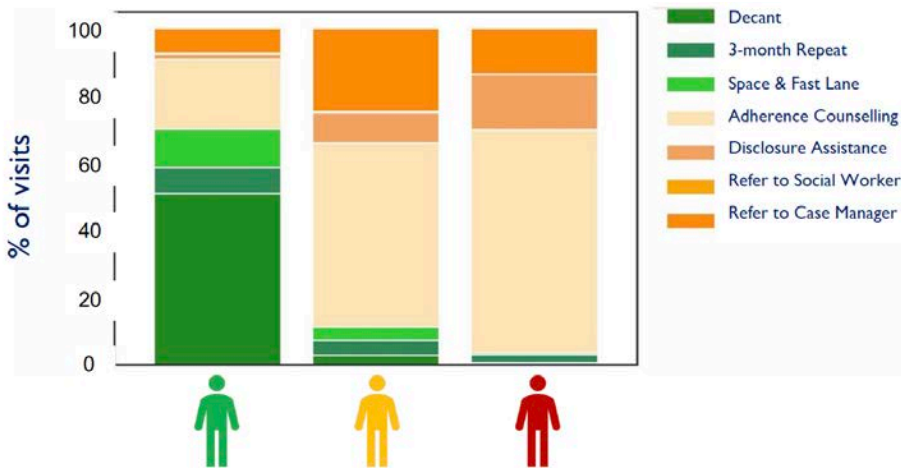
Adherence Scorecard v2.6rx

Scoring Instructions

1. For each question, circle an answer and add the points in the "score" column. Sum all scores into "Total".
 2. Match this score to the "Total Adherence Score", and consider what guidance your client might need.

Adherence Scorecard		0	1	3	Score
Client File	1 What is the client's age group?	Young adult (18-35)	Adult (36-59)	Senior (60+) Child (0-17)	1
	2 For today's visit, is the client:	Late	First visit	On Time	3
	3 For their last visit, was the client:	Unknown	First or second visit	On Time	0
	4 Has the client ever been over a month late?	More than once	Once	Never	1
	5 When was the client's last visit?	5 or more months ago	3-4 months ago	0-2 months ago CCMDD or Fast Lane	3
Psychosocial	6 How many times has the client ever visited this facility?	0 - 4 visits	5 - 10 visits	11 or more visits	0
	7 Have you disclosed your HIV status to your friends or family?	No disclosure	Full disclosure		1
	8 How much time did it take you to get here?	More than 30 mins	30 mins or less		1
	9 How many people do you live with?	Other number	2 - 6 other people		1
	10 Are you employed or studying?	No	Yes		1
Total					12

Total Adherence Score																						
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
low-score											mid-score						high-score					



IV. DISCUSSION

Key points from the workshop discussion are summarized below. Text in italics is quoted or paraphrased from participants.

General comments about and concerns with risk triaging

1. We should not assume that higher risk equates to higher intensity care. *“Some folks at high risk will need the opposite of intensified care. (‘Just leave me alone.’)” “Titration of engagement based on patient needs.”*
2. There is no point to differentiating and segmenting patient groups if we don’t have appropriate interventions to offer to different risk groups. If we can identify appropriate interventions for the right patients, is there someone to deliver them?
3. Concern was also raised over the excessive automation of score calculation – too little HCW involvement could negatively impact on process of engaging and involving the client in the decision-making process.
4. The TB symptom screen may have been adopted widely because there was a clear, felt need for it as well as an established, motivated forum advocating for the development and implementation of the screening tool. There may be such a need for ART retention risk screening now. *“It seems to me from the data that there is currently a clear need to improve targeting of interventions for early ART patients, but I don’t know if providers feel that need.”*
5. Fidelity of implementation of any new tool was noted as a major concern, particularly as we consider scaling. It was observed that even the TB symptom screen, which is extremely simple to implement, is often completed poorly and/or results are not acted on. *“Although the TB screening questions are easy and feasible to implement, in South Africa they are often really poorly done.” “The lack of fidelity in implementing the TB screening tool plus the challenge of interpreting it in complex situations has led SA to adapt a policy of universal TB testing for all PLHIV with a molecular test like GeneXpert.”*
6. Some psychosocial data may be important for predicting future behavior and can be collected and used at the initiation visit. *“... attitudinal variables like how much shame/guilt/fear someone feels around having HIV, how much external stigma they anticipate in their family/community, how hard they think living with HIV is going to be, etc. ... our coaches have found these intuitively to be very predictive of vulnerability/need for support.” “What is driving gap between (patients’) intent and action?”*
7. CD4 count at ART initiation could also be a useful predictor of future behavior. *“There is a new paper from the Western Cape group that argues that starting CD4 count remains a strong predictor of outcomes, mainly because a low CD4 count reveals reluctance to start treatment (which is different from its prognostic value for disease progression). If we are looking for indicators available at the point of ART initiation, should we return to use of CD4 counts?”*
8. Concern was raised about how to handle non-naïve clients (re-initiators), most of whom will not admit to prior ART exposure. Not having accurate data on prior use will limit the accuracy of a risk

score that cannot take that information into account. “... it’s worth asking why patients are so reluctant to disclose prior use.” Some clients may fear being put on second line regimens, which are harder to tolerate. Better implementation of the “Welcome Back” campaign might help.

9. Question asked, “Has anyone done a study where they simply ask new patients what they want? How many visits, how many months script, level of counselling and use this as a means to empower patients to self-assess their own risk and identify what they value and need? Enabling a truly responsive system.” Response that PREFER study of Retain6 is doing this research.
10. Concern was raised about language. The term “risk” implies that the patient is the one doing something wrong, while most often they are vulnerable to disengagement due to forces outside of their control. “Risk” is, however, a standard and very commonly used term in the burden of disease literature and for clarity in reporting the workshop outcomes, we continue to use this terminology here. “(Risk triaging) can sometimes be used to identify “bad patients” in a way that is associated with punishment. HCWs can use it in way that does not benefit patients and can drive them away from intervention.” Going forward with development, thinking through the broader narrative and specific language used as we address those re-engaging in care is important. “Interruptions in treatment are ‘normal’ and should be an anticipated part of the HIV care journey.”
11. Co-morbidities are increasingly common and pose a greater health risk than HIV. Need to incorporate co-morbidities into risk screening, reduce HIV exceptionalism. Integrating the risk scoring tool with other co-morbidities may make it more acceptable.

Timing and implementation of risk triaging

Most participants in the workshop agreed that risk triaging could be useful in routine ART provision, with the following considerations and caveats:

1. Participants expressed serious concerns about healthcare workers’ case-loads and time constraints – implementation of any tool or approach to triaging should consider clinic flow, staff cadres available, infrastructure, and when and for whom triaging should be done. “Simplicity needs to be a key focus.” “There seems to be a tension between too simple vs too perfect.” “Even with the world’s best tool, if healthcare workers don’t get load-balancing relief, there will always be the challenge of quality vs value and that tension is always coming up.” “It needs to be seen as a reduction in workload to HCWs.”
2. Being able to identify those at high risk of disengagement at ART initiation would be very valuable (as opposed to waiting until sometime after initiation). While previous visit data is not available early on, demographic and psychosocial indicators might cover that gap at initiation, with the possible addition of baseline CD4 counts.
3. It might not be feasible or necessary to conduct risk triaging for every client at every visit. Risk triaging in the first 6 months, when most of disengagement from care in the first year occurs, presents the greatest opportunity to reduce the burden of care on the health system and on the more than 50% of participants who do fine and will likely benefit from earlier DSD enrollment.
4. The fact the same risk score may require different interventions (depending on what comprises the score) will be a barrier to implementing with fidelity, particularly as we address the question, “Who will provide these interventions?”

5. Strong support was expressed for self-assessment of risk by clients. *“A survey of what do you want/need today could be completed in the waiting room and then could guide the clinician of what the patient wants.”* This would help address concerns about healthcare provider time and burden and also empower the clients to identify and obtain support for their own needs.
6. Tools should be appropriate to the level of cadre implementing them. That might require different parts of a tool being completed by different client-facing providers. This may ease the potential additional burden imposed on clinical staff with limited consultation time but also creates the potential opportunity for tools to be implemented in a variety of care settings such as with peer supporters in adherence clubs.
7. Anecdotally, patients are willing to wait for care that may attend more to their needs. *“We need to have patients understand that we are willing to help them with all of the issues they experience in accessing care. Even if clinicians can’t help them, model should allow for referral to someone else who can help them.”*
8. Capacity for providing individualized counseling is site-specific—may have to tailor interventions by site.
9. No consensus on paper v digital formats for tools—pros and cons to each. *“Might differ between generations of nurses.”*

PREDICT tool feedback

1. Patients want to be informed and involved in decision-making. Their input and response to the tool should be considered in intervention. *“Patients have challenges initiating treatment, even late in the first year. Including them made them feel important and allowed more time to be spent with high risk patients, as clinician time is precious due to high patient burden. Patients were happy to be involved in their time spent in the clinic (as opposed to dispensing only) and were able to state their challenges not previously asked. It was good for rapport. Patients were more likely to come back as clinician has shown care before.”*
2. Revealed behavior (past visit performance) is a much better predictor of future behavior than are demographic, social, etc. characteristics.
3. How can this be expanded to non-HIV care visits and/or patients who are not living with HIV, but have other comorbidities?
4. Tool can be good way of initiating conversations around risk factors and how they can be addressed.
5. Ideally, some of the questions in the PREDICT tool are already being asked, as such the tool provides health care workers with a means to use time more efficiently. *“The screen (tool) is a nudge - can we show that the nudge had an impact and can we scale those nudges to benefit the provider that they want to keep using it?”*
6. Consider how a risk triaging tool would work within existing DSD models, e.g. for patients receiving external (off site) services.
7. Tool should ideally not be limited to HIV care only.

8. Providers identified the following benefits and challenges after trials of PREDICT:

Benefits:	Challenges
1. Enriched patient conversations	1. Resistance to change
2. Improved time-allocation – promise, but not yet proven in practice	2. Restrictive guidelines not allowing HCW to tailor care
3. Empowered taking tailored action	3. Lack of solutions (interventions) for patients and formalising those solutions
4. Patient agency over risk score	4. HCWs prefer digital solution or integrating with existing stationary rather than separate page.

9. Participants recommended a continuous quality improvement approach, rather than a trial with evaluation at the end.

How would we define success?

1. Approach should be feasible for the setting and accepted both by health care providers and patients.
2. Outcomes should be defined at the outset and could include the following:
 - a. Retention at 1 year
 - b. Patient satisfaction
 - c. Clinical condition (e.g. viral load suppression, TPT completion for those eligible)
 - d. Provider satisfaction – they should be willing and able to use tool
3. Risk triaging tool improves patient outcomes (retention in care, viral load suppression, etc.) when implemented at scale outside of research study, in multiple different settings.
4. Potential use of ENACT-tool (Enhancing Assessment of Common Therapeutic factors) suggested: <https://www.cambridge.org/core/journals/global-mental-health/article/enhancing-assessment-of-common-therapeutic-factors-enact-tool-adaptation-and-psychometric-properties-in-south-africa/C36D0BA839B22E6CA8D8E207F74BB039>
5. It was noted that estimating the benefits and costs of a risk triaging tool like PREDICT requires that it be implemented at scale. A pilot study in which it is used for a fraction of the total patient volume at a particular healthcare facility will not reveal any scale effects on, e.g., healthcare worker time use.

V. NEXT STEPS

Retain6 will continue to examine risk triaging as a component of models of care for clients’ first six months on ART. Anticipated next steps include:

1. Publication of the literature review on the use of risk triaging at the primary healthcare level in sub-Saharan Africa.
2. Further analysis of existing data from PREDICT tool trials and publication of results.
3. Focus group-style discussions with facility-level implementers (nurses, counselors), including those who have utilized PREDICT and those who have not.

4. Engage with workshop attendees and others working in the risk scoring and behavioral segmentation space to explore willingness to consider collaborative workshop/brainstorming sessions to look at psychosocial aspects raised in workshop and possibility of combining approaches.
5. Leverage the Retain6 project activity that identifies and describes the existing body of retention interventions currently available in ART service delivery and consider the feasibility of matching these to PREDICT risk profiles.
6. Adapt the PREDICT tool to the new South African ART treatment guidelines that alter procedures during the early treatment period and allow enrollment in differentiated service delivery models as early as 4 months after ART initiation.

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VII. ANNEXES

Annex 1: Agenda

Annex 2: Participant list

Annex 3: Slides



Agenda for RETAIN6 Workshop

The Use of Risk Triaging in Primary Healthcare in Sub-Saharan Africa

Tuesday, April 18, 2023

Starts: **6:00 am/9:00 am/15h00 pm** PDT/EDT/SAST

Ends: **9:00 am/12:00 pm/18h00 pm** PDT/EDT/SAST

Online

Session	Presenter/ moderator	Time (Tuesday, April 18, 2023)		
		PDT	EDT	SAST
Review of agenda and introduction to Retain6	Sydney Rosen	6:00-6:10	9:00-9:10	15:00-15:10
Literature review: 3 case studies	Linda Sande, Mariet Benade	6:10-6:40	9:10-9:40	15:10-15:40
Risk triaging for ART retention	Mhairi Maskew	6:40-7:00	9:40-10:00	15:40-16:00
Break		7:00-7:30	10:00-10:30	16:00-16:30
Work in progress: PREDICT development and implementation	Palindrome, implementers	7:30-8:00	10:30-11:00	16:30-17:00
Discussion*	Peter Ehrenkranz	8:00-8:50	11:00-11:50	17:00-17:50
Wrap-up and next steps	Sydney Rosen	8:50-9:00	11:50-12:00	17:50-18:00

*Can continue into fourth hour if desired

Workshop hosted by the Retain6 Project of Boston University, HE²RO, and CHAI, with thanks to the Bill & Melinda Gates Foundation.

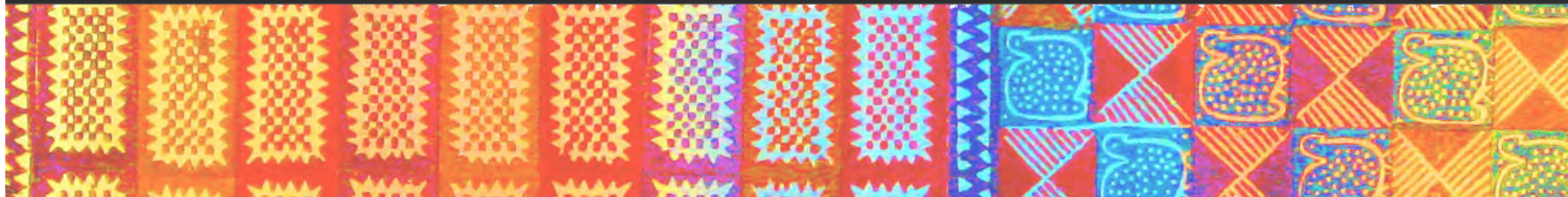
Participants, Retain6 risk triaging workshop, April 18, 2023

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RETAIN6: Risk triaging workshop

April 18th, 2023





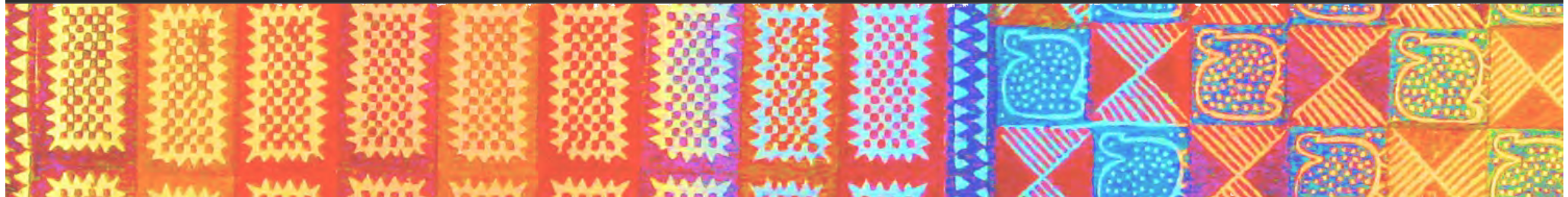
Agenda

Session	Presenter	Time		
		PDT	EDT	SAST
Review of agenda and introduction to Retain6	Sydney Rosen	6:00-6:10	9:00-9:10	15:00-15:10
Literature review: 3 case studies	Linda Sande, Mariet Benade	6:10-6:40	9:10-9:40	15:10-15:40
Risk triaging for ART retention	Mhairi Maskew	6:40-7:00	9:40-10:00	15:40-16:00
Break		7:00-7:30	10:00-10:30	16:00-16:30
Work in progress: PREDICT development and implementation	Palindrome, implementers	7:30-8:00	10:30-11:00	16:30-17:00
Discussion	Peter Ehrenkranz	8:00-8:50	11:00-11:50	17:00-17:50
Wrap-up and next steps	Sydney Rosen	8:50-9:00	11:50-12:00	17:50-18:00

Introduction

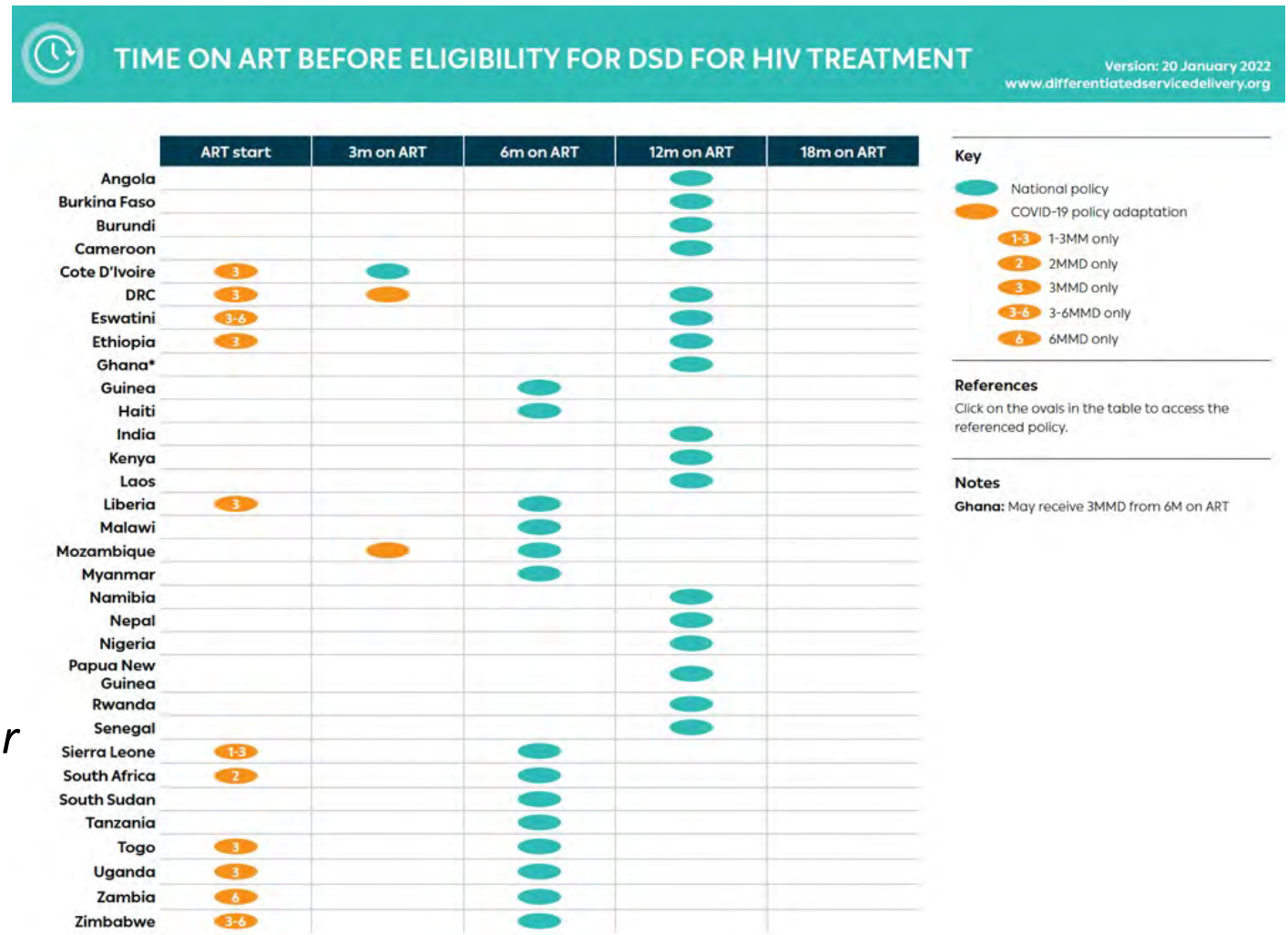


RETAIN6



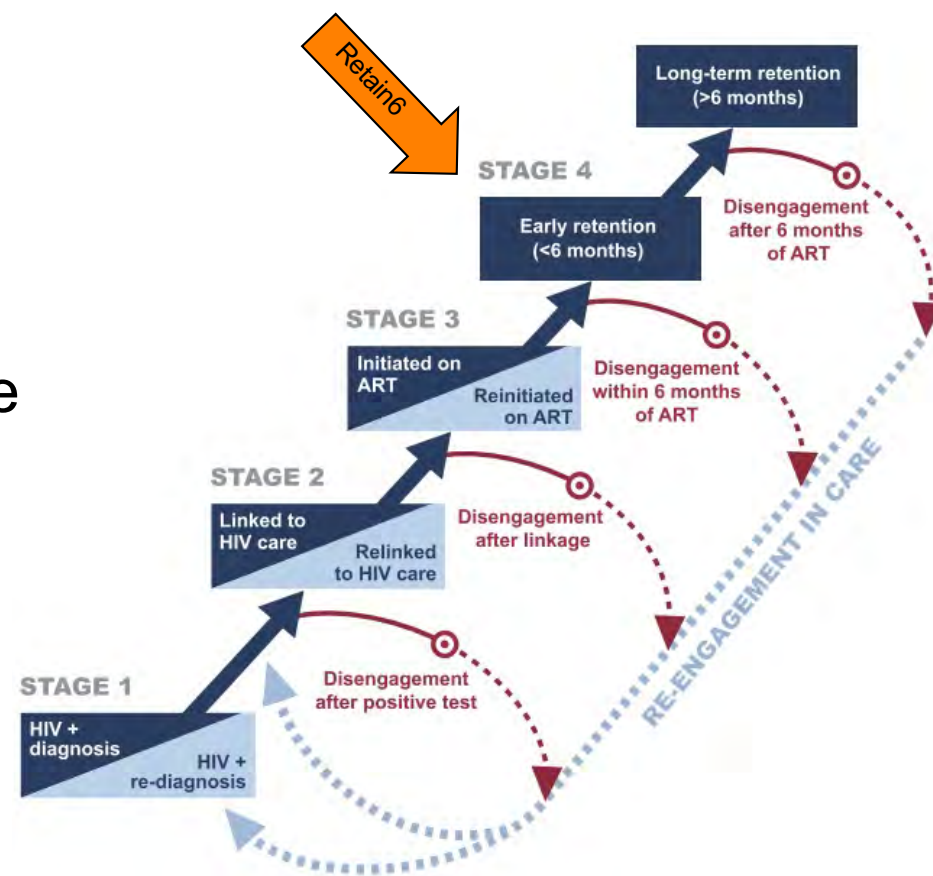
Time on ART required before DSD model eligibility as of January 2022

“Newly-initiated patients are systematically excluded from DSD models during their first six (or 12) months on ART, no matter their conditions, needs, or viral load.”



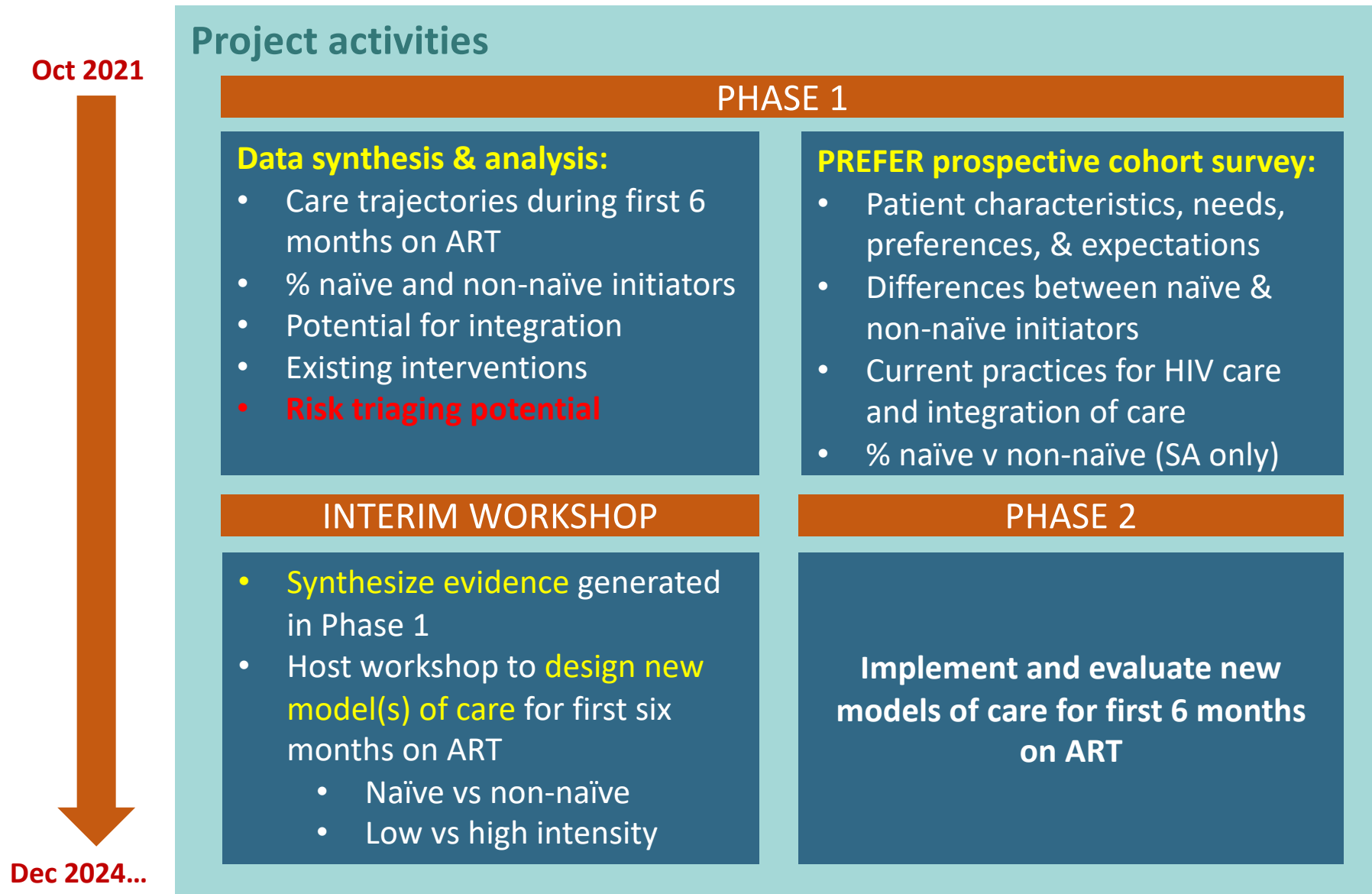
RETAIN6: Models of care for the first six months of HIV treatment

- Optimize service delivery during the “early treatment” period
- Generate evidence to reduce attrition from care between same-day ART initiation and current eligibility for “stable patient” DSD models
- Overall goal is to inform recommendations for models of care for the first 6 months on ART



Source: Ehrenkranz et al, 2021

Two project phases: Currently in Phase 1



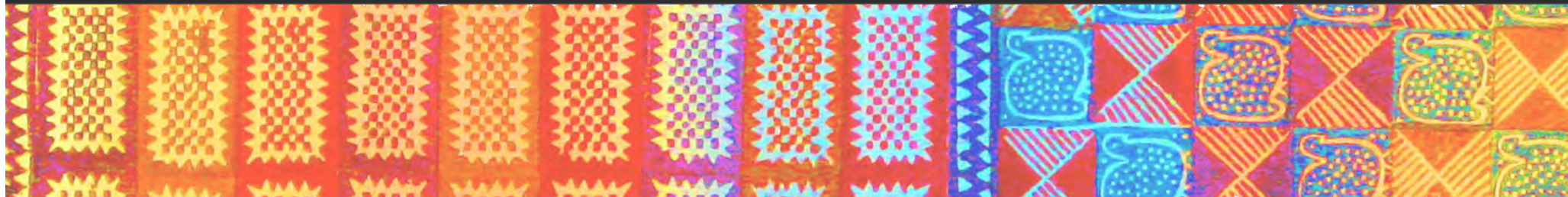


What do we mean by risk triaging?

- We define risk triaging as the process of identifying and stratifying a healthcare client's risks of future negative outcomes.
- Risk triaging \neq diagnosis. It is a screening tool to prioritize individuals for further intervention (diagnosis or preventative actions).
 - For example, in South Africa and Zambia the WHO TB symptom screen is a risk triaging tool; Xpert MTB is a diagnostic tool.
- Risk triaging \neq intervention. First you identify risks, then match risk profiles to interventions.
- For Retain6, we are interested in characteristics of clients, their communities, healthcare facilities, and/or service delivery that predict future disengagement from HIV treatment.
- Question for this workshop: **Can risk triaging feasibly be incorporated into routine ART delivery in South Africa and other countries using existing resources?**

Experience with risk triaging tools in Sub Saharan Africa: case studies

What informative examples do we have of
risk triaging applied to priority health
conditions in a primary healthcare setting?





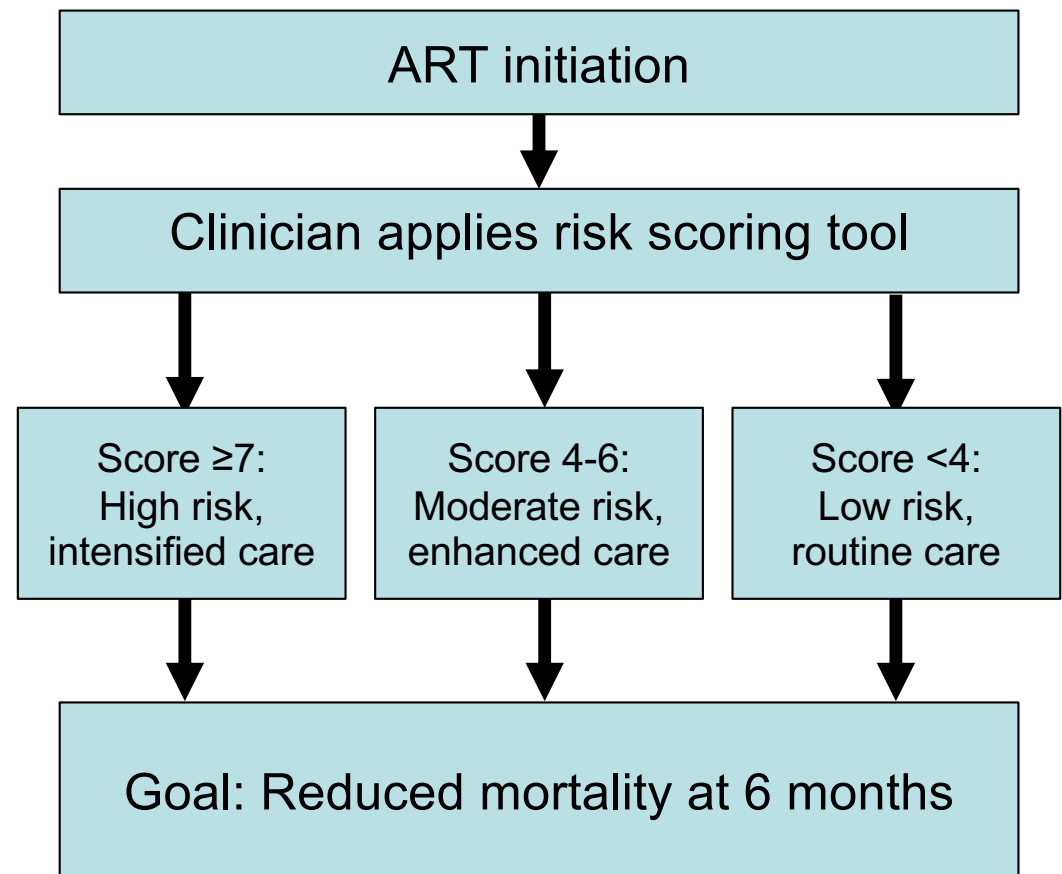
Background

- Prediction or risk scoring/triaging tools have a long history of use in hospitals and in high-income countries.
- We conducted a systematic literature review of the use of risk triaging in chronic conditions in primary healthcare settings in SSA.
- **Review question:** How has risk triaging previously been used in primary healthcare clinics in SSA, and to what extent has it succeeded?

Case 1: Applying a risk scoring tool to inform care intensification and reduce mortality

Source: Auld et al. (2020), “Risk scores for predicting early antiretroviral therapy mortality in sub-Saharan Africa to inform who needs intensification of care: a derivation and external validation cohort study”

- Used Botswana trial data to identify patient characteristics predictive of 6-month mortality and triage high-risk patients for intensified care.
- Identified sex (male), TB symptoms (≥ 1), WHO stage III/IV, severe anemia, and fever as predictive.
- Created a “clinical risk score” based on number of predictive characteristics.



Case 1 continued

- Tool modestly improved sensitivity and specificity compared to SOC using CD4 count and WHO stage only
- Tool had better results even when no CD4 count available
- “Our risk scores are careful to be simple (5 or 6 variables assessed), use objective covariates rather than variables that are more open to interpretation, and use variables that should be available, or could easily be made available, at the POC in LMIC. Our score could be relatively easily included in paper medical records relevant for the first HIV clinic or ART initiation visit and should not require a calculator.”

		← NO		Is CD4 Count Currently Available?		→ YES	
Risk Factor	Category	Associated points	Assigned score	Risk Factor	Category	Associated points	Assigned score
Gender	Pregnant Female	0		Gender	Pregnant Female	0	
	Non-pregnant Female	1			Non-pregnant Female	1	
	Male	2	+		Male	2	+
No. of WHO TB symptoms	Zero	0	+	No. of WHO TB symptoms	Zero	0	+
	≥1	1	+		≥1	2	+
WHO Disease stage	I or II	0	+	WHO Disease stage	I or II	0	+
	III or IV	2	+		III or IV	2	+
Temperature (°C)	≤37.5	0	+	Temperature (°C)	≤37.5	0	+
	>37.5	2	+		>37.5	2	+
Hemoglobin Level	No anemia	0		CD4 Count (cells/μL)	≥200	0	+
	Mild/Mod. anemia	2			<200	1	+
	Severe anemia	3	+		Hemoglobin Level	No anemia	0
Total				Mild/Mod. anemia		3	
				Severe anemia		4	+
				Total			+

Fig. 4 CD4-independent and CD4-dependent clinical score cards

Case 2: Risk triaging for HIV prevention: The VOICE risk score

Source: Balkus et al. (2016), “An empiric HIV risk scoring tool to predict HIV-1 acquisition in African women”

- Risk score to be used to predict HIV acquisition among African women to inform targeting of prevention interventions
- Score developed and validated with data from 3 HIV prevention trials in Eastern and Southern Africa
- “Sharp increase in HIV incidence among participants with risk scores ≥ 5 ”
- Tool had good predictive ability and expected to be easily implemented in different settings

Characteristics	With laboratory-based variables	Without laboratory-based variables
Age <25	2	2
Not married nor living with partner	2	2
Alcohol use in the past 3 months	1	1
Partner does not provide financial or material support	1	1
Primary sex partner has other partners: Yes/Don't know	2/2	2/2
Any curable STIs	1	-
HSV-2 seropositive	2	-



Case 2: Applying a risk scoring tool to predict HIV acquisition for prevention targeting

Sources: Balkus et al. (2018), “Performance of a validated risk score to predict HIV-1 acquisition among African women participating in a trial of the dapivirine vaginal ring;” Peebles et al. (2020), “Age-specific risk scores do not improve HIV-1 prediction among women in South Africa.”

Category	Detail
Context	Applying a risk scoring tool to predict HIV acquisition with the aim of targeting PrEP delivery
Setting	Malawi, South Africa, Uganda, Zimbabwe
Motivation	High risk of HIV acquisition among adolescent girls and young women
Tool contents	Adaption of an existing tool and applicability in clinical settings in sub-Saharan Africa
Development	Trial data
Implementation	Expected to use a scorecard
Indicators	Demographics, clinical, behavioural and contextual. ≥5 items

Case 2 continued

- Tools had modest predictive ability.
- *Balkus et al. (2018): Adaption of the VOICE risk score (Balkus et al. 2016)*
 - Cutoff: ≥ 3 points
- *Peebles et al. (2020): Better performance when included laboratory-based variables*
 - Optimal threshold: ≥ 5 points when including laboratory-based variables; ≥ 3 points excluding laboratory-based variables
 - Comparable performance to the VOICE risk score

From Balkus et al. (2018) – Adapted VOICE risk scoring tool

Characteristics	Risk score points
Age <25 years	2
Unmarried/not living with partner	2
Primary partner has other partners: no/don't know	2
Alcohol use in the past 3 months	1
Having a curable STI at baseline	1

Case 2 continued

- Peebles et al. (2020), *“Developing age-specific risk scoring tools and validation of VOICE risk scoring tool”*

Characteristics	Age: 18-24		Age: 25-35	
	With laboratory-based variables	Without laboratory-based variables	With laboratory-based variables	Without laboratory-based variables
Age <27	-	-	1	1
Unmarried nor living with partner	-	-	1	1
Weekly alcohol consumption	1	1	-	-
HIV prevalence	2	2	-	-
Province	-	-	3	3
# of sex partners in previous 3 months	2	2	-	-
Partner has sex with others	1	1	-	-
Frequency of condom use	1	1	-	-
N. gonorrhoeae	3	-	1	-
HSV-2 positive	1	-	1	-

Case 3: A rare success: the WHO TB symptom screen

How did the WHO TB symptom screen become a near-universally used risk triaging tool?

- Two-tier strategy to ensure PLHIV were being served well in the TB program
 - Advocacy
 - Scientific meetings
- Consensus was forged by bringing together groups with disparate priorities (i.e., HIV people and TB people)
 - TB should be addressed as a key concern for PLHIV
 - Among PLHIV, TB IRIS should be the main concern
- Meta-analysis was conducted in parallel
 - Primary data from 30,000 individuals
- Data convinced WHO HIV department
 - Incorporated TB for PLHIV into guidelines in 2011
 - Systematic screening for TB among key populations introduced in 2013
- Minimal technical support to member states provided through consultancies and training for national guideline development (but no direct implementation support)
- WHO estimates W4SS has saved 8-12 million lives

DPPIR ACCESS Freely available online

PLOS MEDICINE

Development of a Standardized Screening Rule for Tuberculosis in People Living with HIV in Resource-Constrained Settings: Individual Participant Data Meta-analysis of Observational Studies

Haileyesus Getahun^{1*}, Wanitchaya Kittikraisak², Charles M. Heilig³, Elizabeth L. Corbett⁴, Helen Ayles^{4,5}, Kevin P. Cain³, Allison D. Grant⁶, Gavin J. Churchyard⁶, Michael Kimerling⁷, Sarita Shah⁸, Stephen D. Lawn^{4,9}, Robin Wood⁹, Gary Maartens¹⁰, Reuben Granich¹, Anand A. Date¹, Jay K. Varma^{2,3}

Engage in
advocacy

Meta-analysis
(2011)

Buy-in from
WHO HIV
department

WHO
guidelines
developed

National
guideline
development

Global Fund
Collaboration

Case 3 continued

ADULT TB SYMPTOM SCREENING				
Symptoms				
Temperature	BP	Pulse	Weight	Height
Cough ≥ 2 weeks OR of any duration if HIV- positive			Yes	No
Persistent fever > 2 weeks			Yes	No
Unexplained weight loss > 1.5 kg in a month			Yes	No
Drenching night sweats > 2 weeks			Yes	No
MEDICAL HISTORY				
Close contact of a person with infectious TB		Yes	No	Unknown
Type of index patient		DS TB		MDR/XDR TB
Diabetes		Yes	No	Unknown
HIV status		Positive	Negative	Unknown

Features:

- Utilized questions that clinicians were likely already asking their patients as part of routine care
- Simple and could be administered by lower staff cadres
- Inexpensive to implement (e.g. routine notes or stamp)



Feasible to implement at scale in low-resource settings




Case 3 continued

Advice for future health tool development:

1. Involve policy makers, program managers, and national authorities from the start.
2. Rely on the data.
3. Secure leadership from the WHO.
4. Get all the key people in the room together, even when they don't routinely collaborate.
5. Once you have consensus, go all out for implementation—don't pilot.

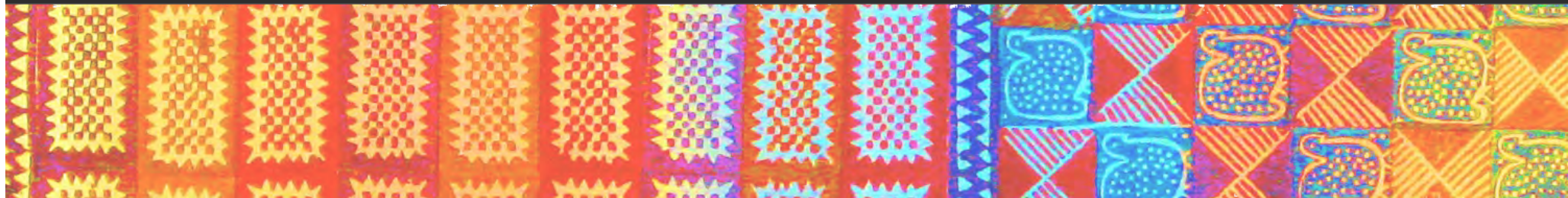
Source: Dr. Haileyesus Getahun,
former Coordinator of the TB/HIV and community engagement unit
at the WHO Stop TB Department



Lessons from the case studies and other studies and experience

Topic	Lesson
Risk triaging as an intervention approach	<ul style="list-style-type: none">• Purpose is to identify patients who most likely do <u>not</u> need additional services, so that we can focus resources on those who might.• Context and population of interest matter a lot when choosing indicators to be included in risk-scoring tools• Engage policy makers, potential users, and other stakeholders as early as possible in the process (at the beginning).• Risk triaging is only useful if we have a response strategy matched to each risk category.
Risk scoring tools	<ul style="list-style-type: none">• Keep risk scoring tools short and objective.• Minimize need for new indicators or information that is not already collected.• Cannot increase real or perceived burden or time commitment for healthcare workers (but there may be a short-term/long-term tradeoff in time allocation)

Risk triaging for ART retention





What is a successful HIV care journey?

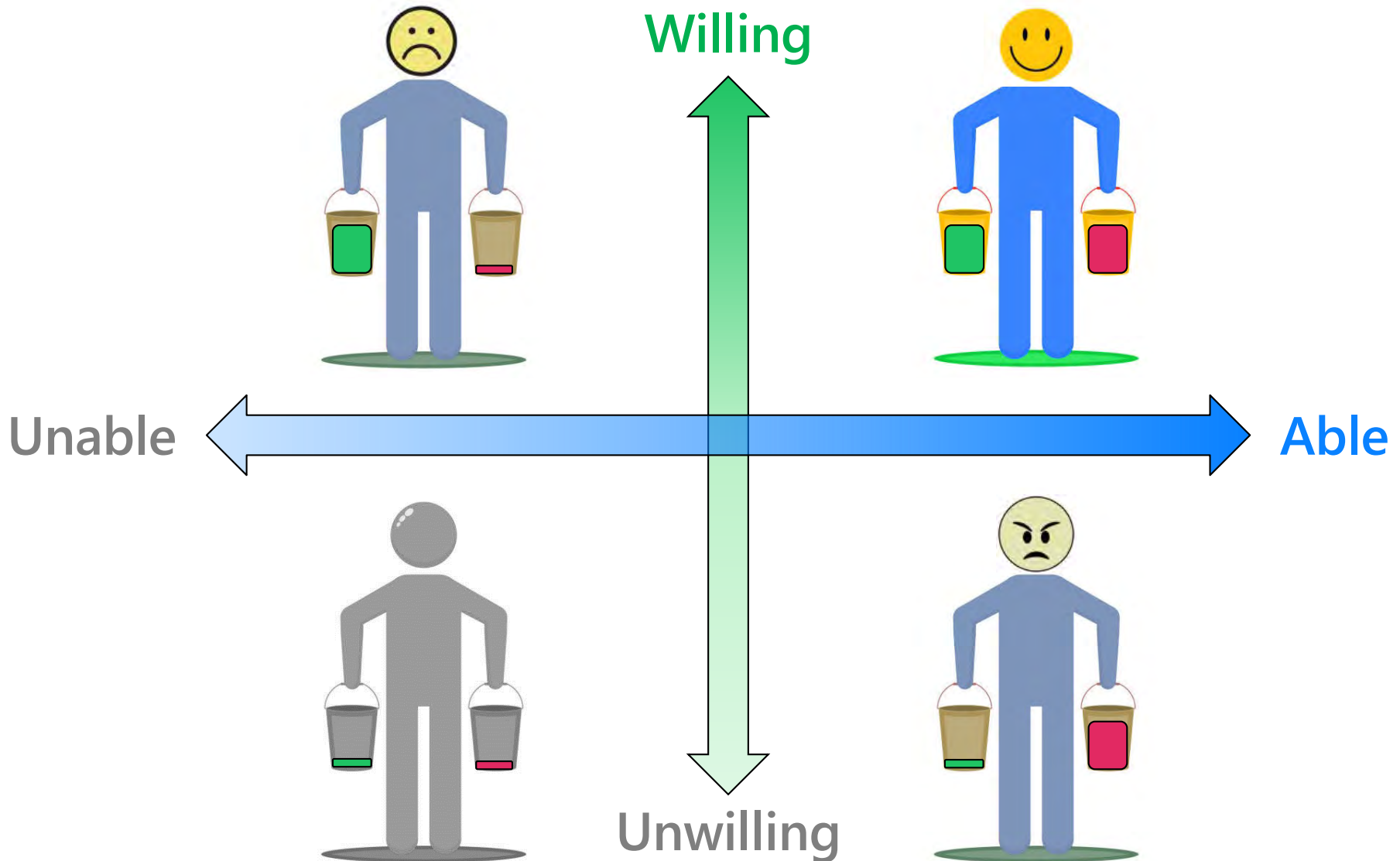
- Uptake of HIV testing services
- Successful, prompt linkage from testing to treatment
- Consistent attendance at clinical and medication pickup visits
- Adherence to medication dosing schedule
- Sustained viral suppression

What does this require?

- An individual equipped with the tools, resources and support to sustain engagement in HIV care:

“Willing” and “Able”

Willing and able – two overlapping scales

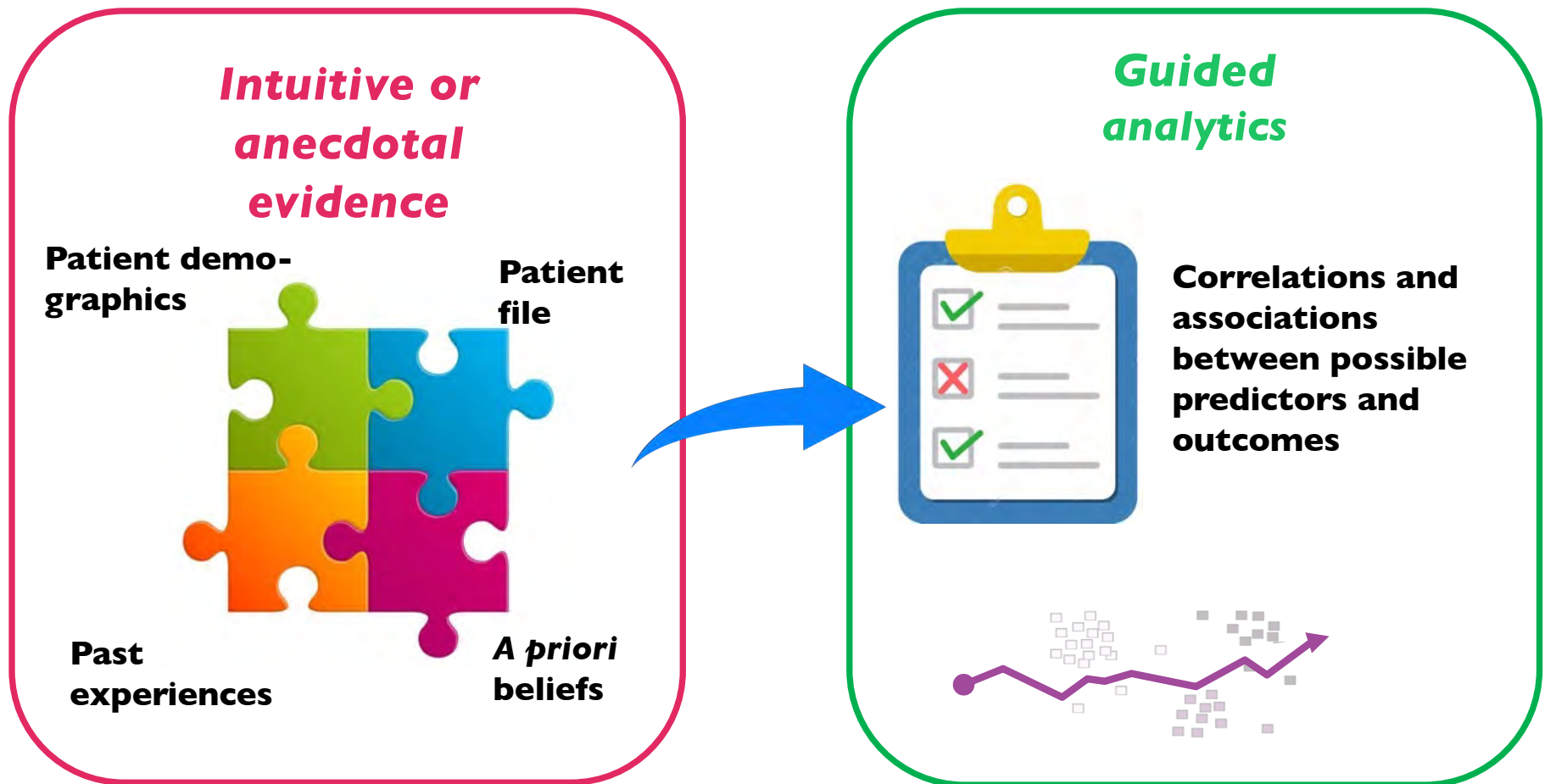


How is this relevant to risk triaging?

- **Willing** and **able** individuals are at low risk of interruption in treatment (IIT) and likely require little intervention to successfully continue their care journey
- **Unwilling** or **unable** groups are both at higher risk of interrupting treatment but likely require different services (interventions) and options based on their risk category
- Once we know an individual's risk, we can match it to an appropriate response.
- First, we need to assign early ART clients to different categories of risk of future IIT...

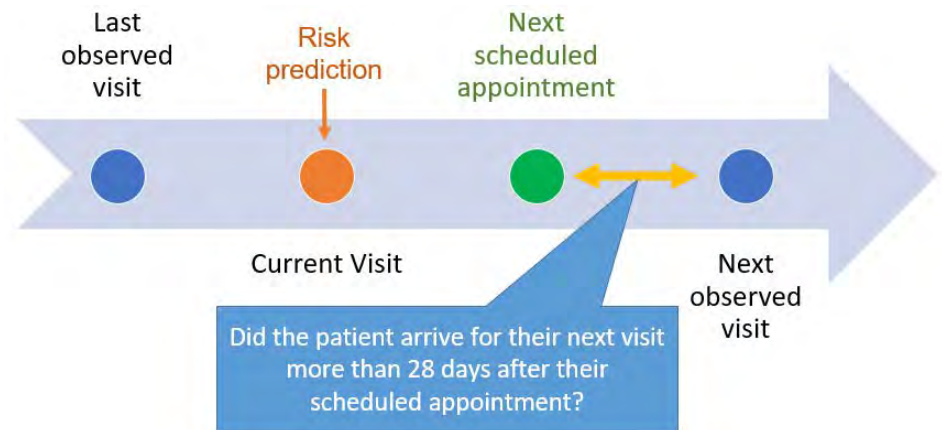


What tools do we have to identify risk?



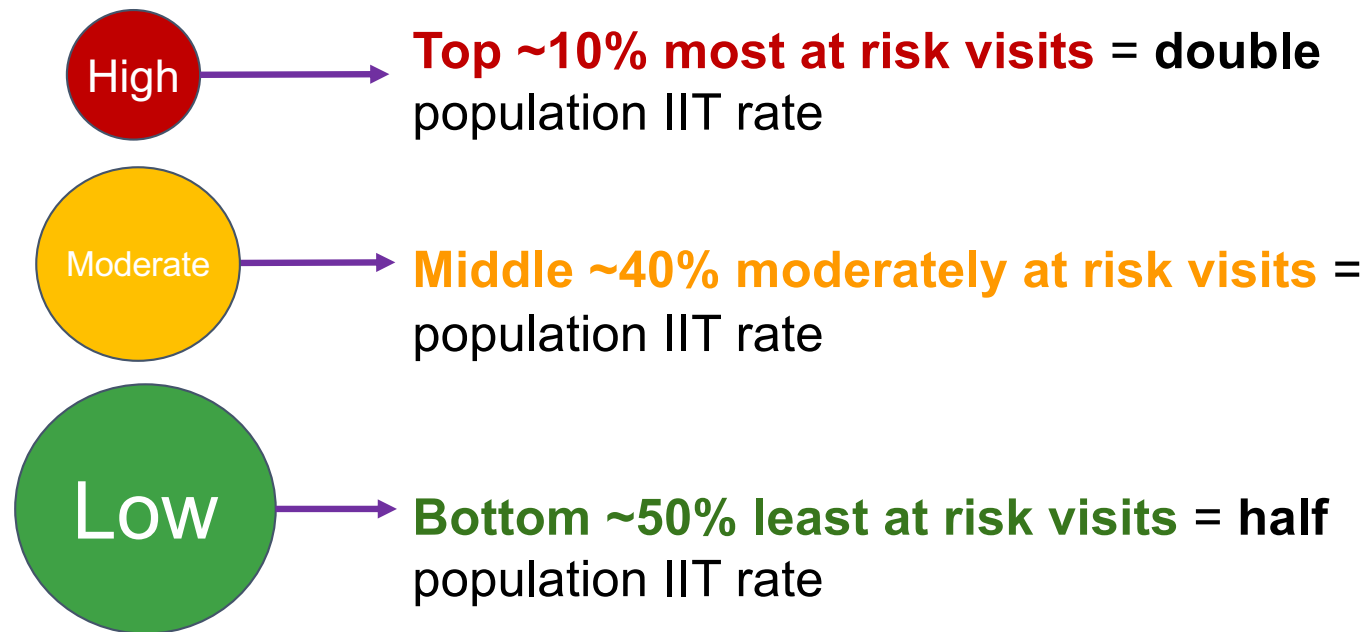
Do we have the methods and tools needed to predict risk of treatment interruptions?

- PREDICT model
- Routinely collected EMR data from:
 - >310,000 ART clients
 - Districts in Mpumalanga and Free State
- Model predicted risk score for IIT for each observed visit using machine learning approaches
- Tested against known visit outcomes
- Predicted 2 of 3 treatment interruptions



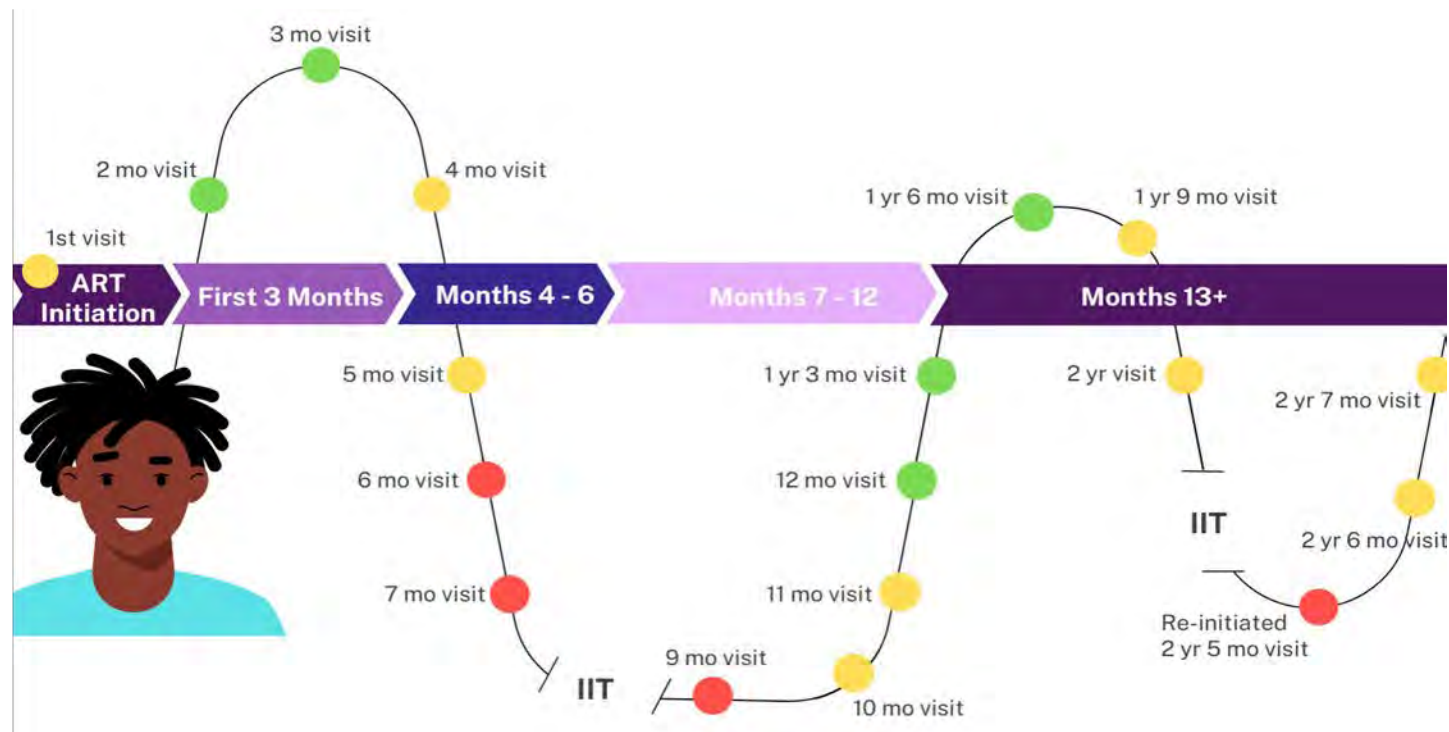
How can risk scores be used to triage patients?



- **Threshold approach** - similar to casualty/field triaging
- Groups are segmented based on a visit-based risk score rather than condition urgency or perceived priority of need for intervention



Risk is dynamic

- Individual circumstances, experiences, life events, and perceptions change over time
- These affect health-seeking behavior and risk of disengagement
- Risk scoring with a threshold approach can be applied at each patient encounter, capturing changes in risk over time



		Current Visit Risk Group		
		Green (low risk)	Yellow (Mod risk)	Red (high risk)
Previous Visit Risk Group	G	85% (84 - 86%)	15% (11 - 17%)	1% (0 - 5%)
		n= 2658; IIT 7%	 n= 436; IIT 16%	n= 37; IIT 35%
	Y		62% (60 - 64%)	10% (7 - 14%)
			n= 1630; IIT 16%	 n= 267; IIT 26%
	R			37% (31 - 43%)
				n= 231; IIT 32%

- Changes in risk states are important – increasing risk shift (G→Y→R) doubles risk of IIT
- State changes tend to occur in transition – only 1% of visits switch from low to high risk states (e.g. G →R)
- Observing these shifts can prompt intervention, allowing a proactive approach before ITT happens



Can we understand drivers of risk?

- Threshold approach can identify groups at risk but cannot tell us why or where to intervene
- We combined it with ML output to look for clusters with shared characteristics that could be driving risk

Traditional demographic risk categories

Category	Description
Adolescent Girls and Young Women (AGYW)	Female AND >15 years and <25 years
Adolescent Boys and Young Men (ABYM)	Male AND >15 years and <25 years
Adult Females	Female AND >24 years
Adult Males	Male AND >24 years

Can we understand drivers of risk?

Group by demographics only	n	IIT%	vs ADULT FEMALES		
			Absolute risk difference	RR	95% CI
<i>ADULT FEMALES</i>	4,855	13.4%	-	1.00	-
AGYW	496	16.0%	3%	1.17	0.94 - 1.45
ADULT MALES	176	13.0%	0%	0.97	0.66 - 1.44
ABYM	2,960	14.0%	1%	1.01	0.9 - 1.13



Can we understand drivers of risk?

Revised behavioral risk categories

Category	Description
Super green	Punctual visit attendance, doesn't live alone
Employed youth at payday	Age 18-29, identify as employed AND next visit scheduled <7 days from payday
Prior test and prompt	Has a history of HIV testing (before testing positive) AND regularly prompt for visits
Lone ranger	Lives alone or with 1 other person AND lives more than 20 mins away
Unexpected and unsupported	Was not planning to test for HIV today AND lives alone/with 1 other person
Disillusioned disclosers	Identifies as having HIV info, has disclosed, lives alone or with 1 other person
Live close always late	Lives <20 mins from clinic but is also regularly late for appointments
Prepared and late	Prepared to start ART today, has tested before but is late to appointments

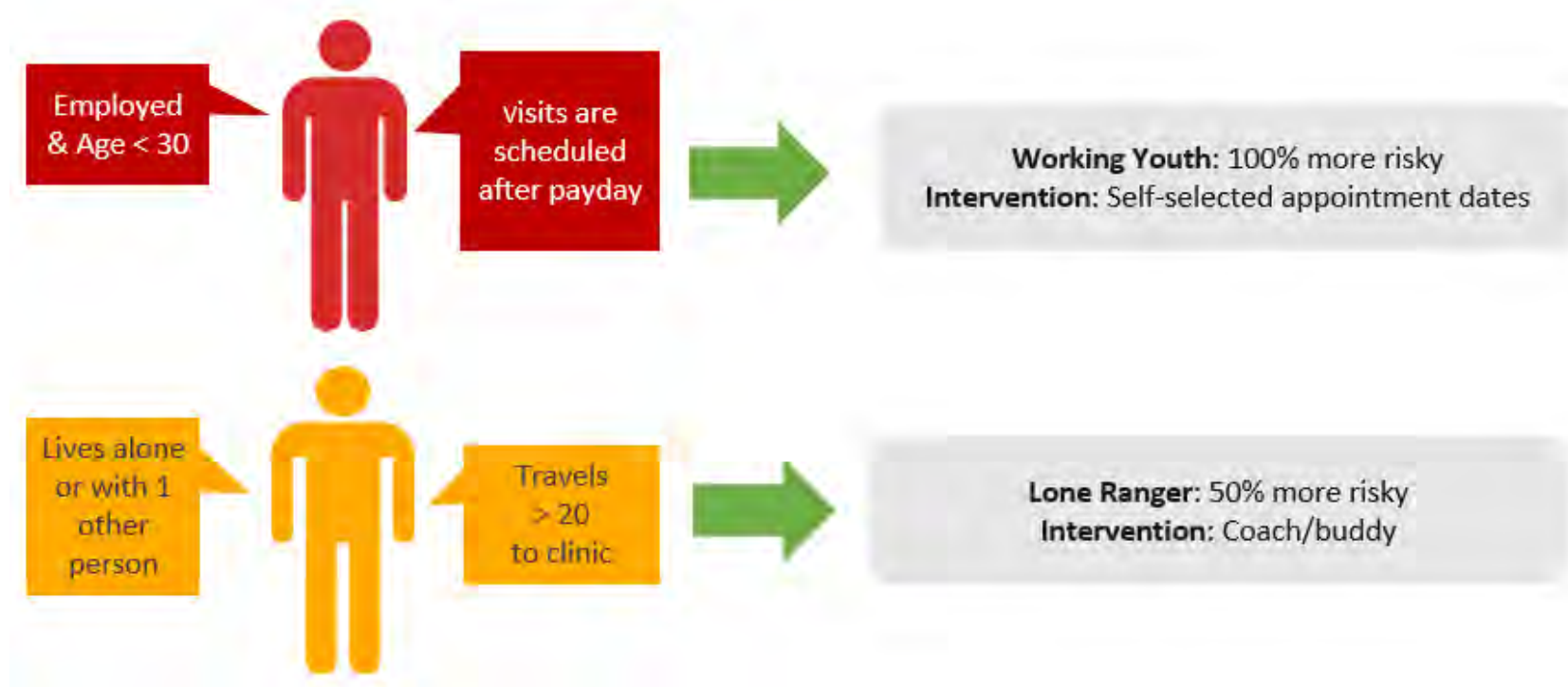
Can we understand drivers of risk?

Group by behaviour only	n	IIT%	vs ADULT FEMALES			
			Absolute risk difference	OR	RR	95% CI
<i>ADULT FEMALES</i>	4 920	13.3%	-	1	1.00	-
RETURNING INTERRUPTER	1,123	20.0%	0.07	1.68	1.55	1.35 - 1.78
LATE TWICE	999	18.0%	0.05	1.51	1.41	1.21 - 1.65
PREPARED AND LATE	551	18.0%	0.05	1.47	1.38	1.14 - 1.68
LIVE CLOSE ALWAYS LATE	1,138	17.0%	0.04	1.39	1.33	1.13 - 1.55
PROMPT & LOYAL	1,593	15.0%	0.02	1.22	1.19	1.03 - 1.36
DISILLUSIONED DISCLOSERS	1,394	15.0%	0.02	1.2	1.17	1.02 - 1.34
LONE RANGER	1,739	14.0%	0.01	1.12	1.11	0.96 - 1.27
UNEXPECTED UNSUPPORTED	964	14.0%	0.01	1.11	1.1	0.92 - 1.31
PRIOR TEST AND PROMPT	2,013	13.0%	0	0.97	0.97	0.85 - 1.12
EMPLOYED YOUTH PAYDAY	347	13.0%	0	0.95	0.96	0.73 - 1.26
SUPER GREEN	2,739	11.0%	-0.02	0.69	0.72	0.63 - 0.83

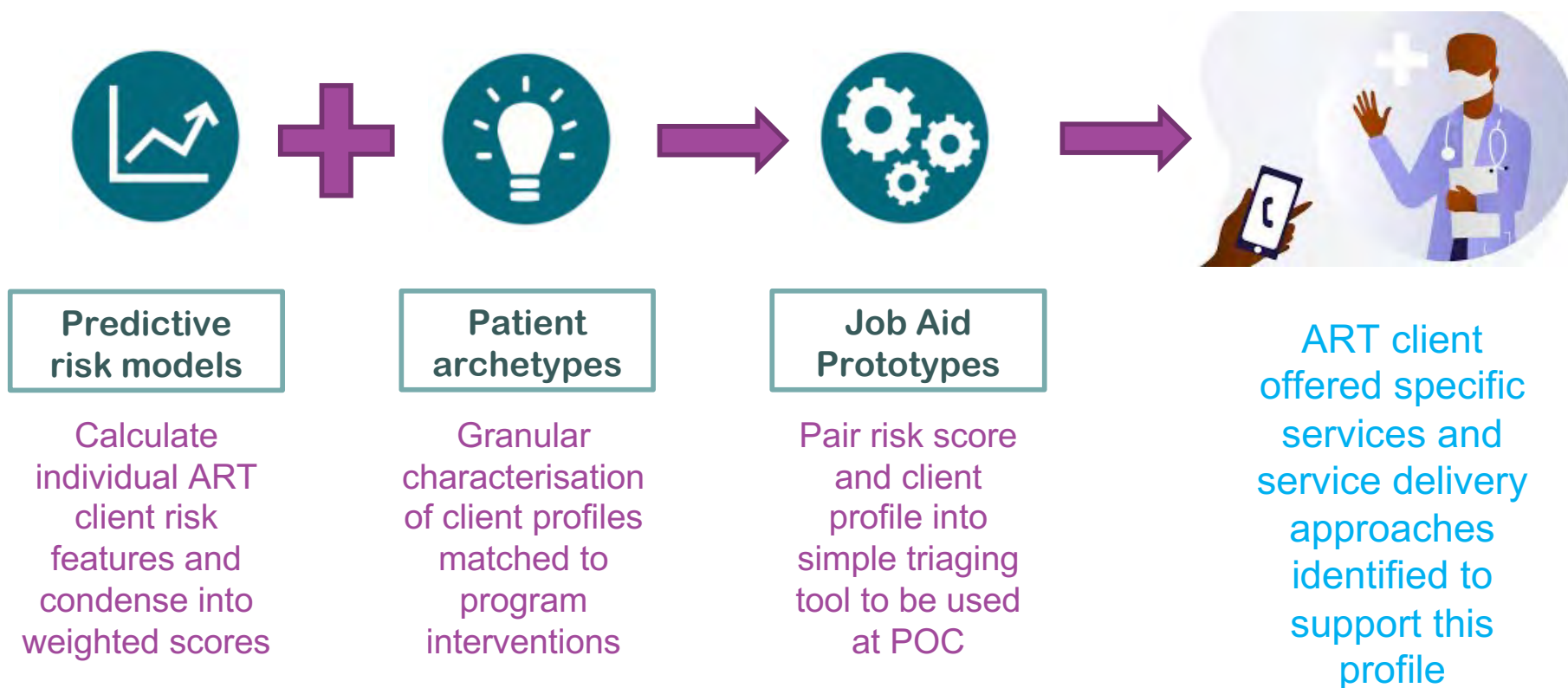
Group by demographics AND behaviour	n	Pop%	IIT%	vs ADULT FEMALES			
				Abs	OR	RR	95% CI
ADULT FEMALES	4 920	57%	13.3%	-	1	1.00	-
ABYM RETURNING INTERRUPTER	23	0.3%	34.8%	0.214	3.44	2.59	1.473 - 4.555
ABYM LATE TWICE	21	0.2%	23.8%	0.104	2.01	1.77	0.822 - 3.823
AGYW LATE TWICE	61	0.7%	23.0%	0.096	1.92	1.71	1.074 - 2.719
AGYW RETURNING INTERRUPTER	50	0.6%	22.0%	0.086	1.82	1.64	0.967 - 2.776
ADULT FEMALES RETURNING INTERRUPTER	651	7.7%	18.9%	0.055	1.62	1.50	1.256 - 1.795
ADULT MALES RETURNING INTERRUPTER	399	4.7%	19.3%	0.059	1.54	1.44	1.161 - 1.779
ADULT FEMALES LATE TWICE	563	6.6%	17.6%	0.042	1.44	1.37	1.124 - 1.657
ADULT MALES LATE TWICE	354	4.2%	18.1%	0.047	1.42	1.35	1.066 - 1.700
AGYW PROMPT LOYAL	119	1.4%	16.8%	0.034	1.3	1.25	0.834 - 1.878
ADULT MALES PROMPT LOYAL	548	6.5%	15.9%	0.025	1.22	1.18	0.962 - 1.452
ADULT FEMALES PROMPT LOYAL	895	10.5%	15.2%	0.018	1.2	1.17	0.979 - 1.388
ABYM PROMPT LOYAL	31	0.4%	9.7%	-0.037	0.69	0.72	0.245 - 2.118

How can this help us intervene?

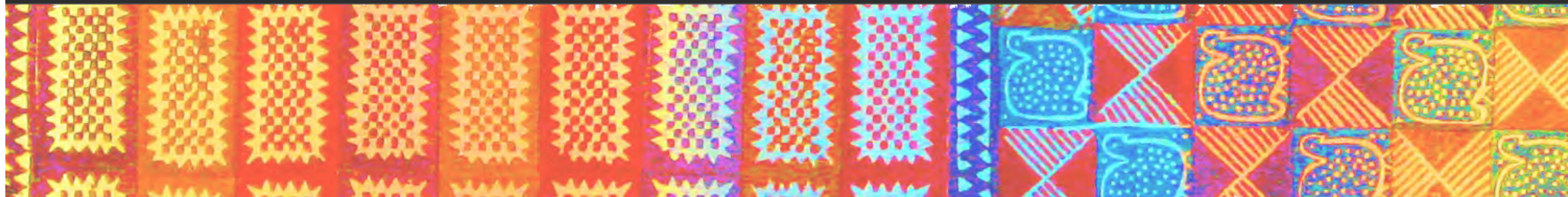
- We can pair combined demographic and behavioral profiles with interventions that are relevant, timely, and responsive to individual needs
- Start to open the lid on “unable” and “unwilling” buckets



Practical solutions to bridging the gap



Predicting risk of disengagement from care – implementation approach



Machine learning triage can be used at 3 levels

@ Point of care level to improve individual outcomes:

“Where is this patient struggling?”

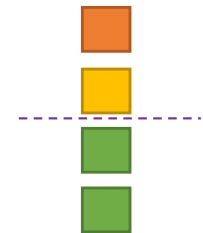
“What can we offer them?”



@ Facility level to improve site efficiency:

“Which patients *have* to be intervened with today?”

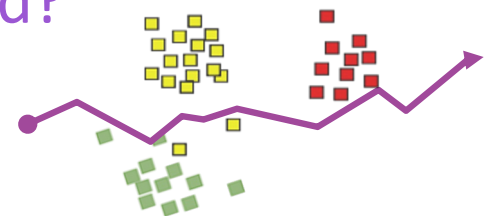
“What interventions can we give group X?”



@ Programme design level to improve resource allocation

“Which segments are under/over served?”

“Where are these segments?”



How is it used at clinic level?



Adherence Scorecard



Scoring Instructions

1. For each question, circle an answer and add the points in the "score" column. Sum all scores into "Total".
2. Match this score to the "Total Adherence Score", and consider what guidance your client might need.

Adherence Scorecard		0	1	3	Score
Client File	1 What is the client's age group?	Young adult (18-35)	Adult (36-59)	Senior (60+) Child (0-17)	1
	2 For today's visit, is the client:	Late	First visit	On Time Early	3
	3 For their last visit, was the client:	Unknown Late	First or second visit	On Time Early	0
	4 Has the client ever been over a month late?	More than once	Once	Never	1
	5 When was the client's last visit?	5 or more months ago	3-4 months ago First visit	0-2 months ago CCMDD or Fast Lane	3
	6 How many times has the client ever visited this facility?	0 - 4 visits	5 - 10 visits	11 or more visits	0
Psychosocial	7 Have you disclosed your HIV status to your friends or family?	No disclosure Partial	Full disclosure		1
	8 How much time did it take you to get here?	More than 30 mins	30 mins or less		1
	9 How many people do you live with?	Other number	2 - 6 other people		1
	10 Are you employed or studying?	No	Yes		1
				Total	12

'File history' - helps identify how stable is the treatment journey

'Psychosocial' section - helps identify and discuss patient struggles

Total Adherence Score

0 1 2 3 4 5 6 7 8 9 10	11 12 13 14 15 16	17 18 19 20 21 22
low-score	mid-score	high-score

Healthcare worker owns the final decision


Does this client need referral to any services?				
Refer to CSTO/social worker	Decant Patients	3 month Repeat	Space & Fast Lane	Choose Appt Date
Other:	Adherence Counseling	Disclosure Assistance	Refer to Case Manager	None

Do you agree with the score for this client?	Yes	No	
What group should this client be in?	low-score	mid-score	high-score

Comments:	Score-Study-ID# _____
	Health Worker Initials _____

How is it used at facility level?

Patients can be prioritised and allocated to intervention or staff, **before** they arrive



Patient appointment list (HIV, TB)

Selected level: Mathibestad Clinic

Date generated: 15/05/2022

Period: 02/04/2022 - 09/04/2022

Number of records: 13

Signed off by: _____

Designation: _____

Top 10%

Folder number	Surname, Name	Gender	Age	DMOC	Appointment date	Last visit date	Duration on ART (months)	Last Viral load count	Test due	Risk Group	Risk Driver
File number	Wolf, Mira	Female	17	DMOC	02/04/2022	05/05/2022	Duration on ART	Last VL	Yes	High Risk	Young, missed appointments, first 3 months in care
File number	Wiley, Desirae	Female	24	DMOC	04/04/2022	07/05/2022	Duration on ART	Last VL	Yes	High Risk	Young, missed appointments, returning interrupter
File number	Dikeng, Mpho	Male	22	DMOC	03/04/2022	06/05/2022	Duration on ART	Last VL	No	Mid Risk	Young, first 3 months in care
File number	Hodge, Illiana	Female	14	DMOC	02/04/2022	05/05/2022	Duration on ART	Last VL	Yes	Mid Risk	Young, 1 missed appointment
File number	Ortega, Chase	Male	35	DMOC	04/04/2022	07/05/2022	Duration on ART	Last VL	No	Mid Risk	Missed appointments
File number	Mcdaniel, Tara	Female	42	DMOC	02/04/2022	05/05/2022	Duration on ART	Last VL	Yes	Mid Risk	Missed appointments
File number	Nhlapho, Sizwe	Male	28	DMOC	04/04/2022	07/05/2022	Duration on ART	Last VL	No	Mid Risk	Mid-range VL, first 3 months in care
File number	Jarvis, Leandra	Female	33	DMOC	03/04/2022	06/05/2022	Duration on ART	Last VL	No	Low Risk	Mid-age, prompt & loyal
File number	Monrie, Nyssa	Female	22	DMOC	02/04/2022	04/05/2022	Duration on ART	Last VL	No	Low Risk	Undetectable VL, 6+ months in care
File number	Lott, Clarke	Male	55	DMOC	03/04/2022	06/05/2022	Duration on ART	Last VL	No	Low Risk	Older, 6+ months in care
File number	Andrews, Jeremy	Male	37	DMOC	02/04/2022	05/05/2022	Duration on ART	Last VL	Yes	Low Risk	Mid-age, prompt & loyal
File number	Moss, Johan	Male	40	DMOC	02/04/2022	04/05/2022	Duration on ART	Last VL	No	Low Risk	Mid-age, undetectable VL
File number	Ndlovu, Thandi	Female	31	DMOC	04/04/2022	07/05/2022	Duration on ART	Last VL	No	Low Risk	Mid-age, prompt & loyal

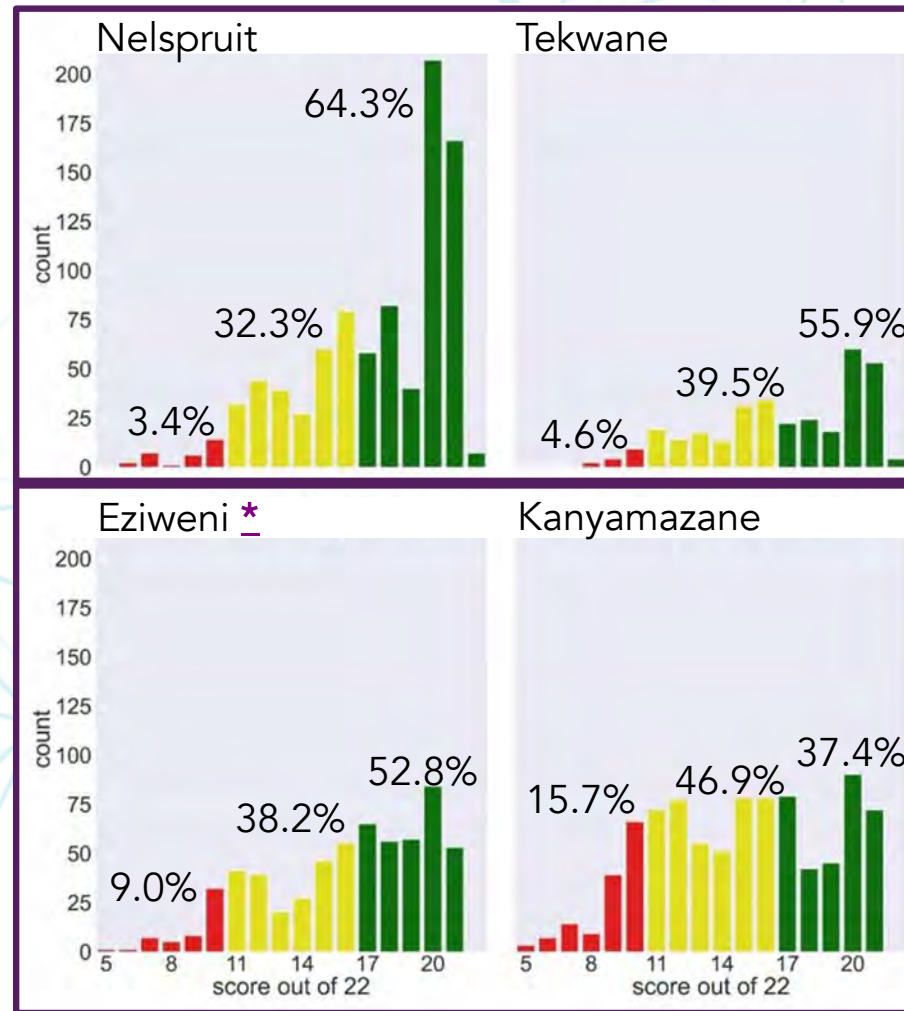
How is it used at programme management level?



Reveals the distribution of risk profiles across sites and geographic areas; allows resources to be directed where needed.

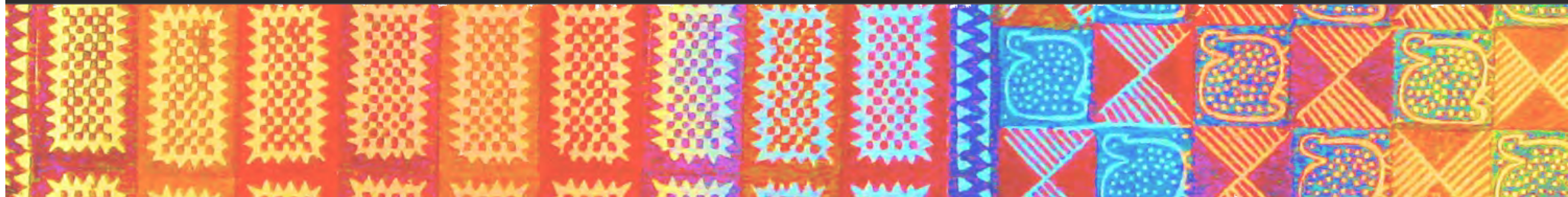
DIGITAL USERS

PAPER USERS



Score Colour
R
Y
G

Predicting risk of disengagement from care – point of care feasibility study insights



Feasibility study in Mpumalanga

1. **Feasibility study** scoring clinic visits over 4 months, in 4 sites
2. **Measuring** uptake, acceptability, fidelity and outcomes
3. **Inclusive design, with input from HCW, program staff, academics**



Feasibility study in Mpumalanga

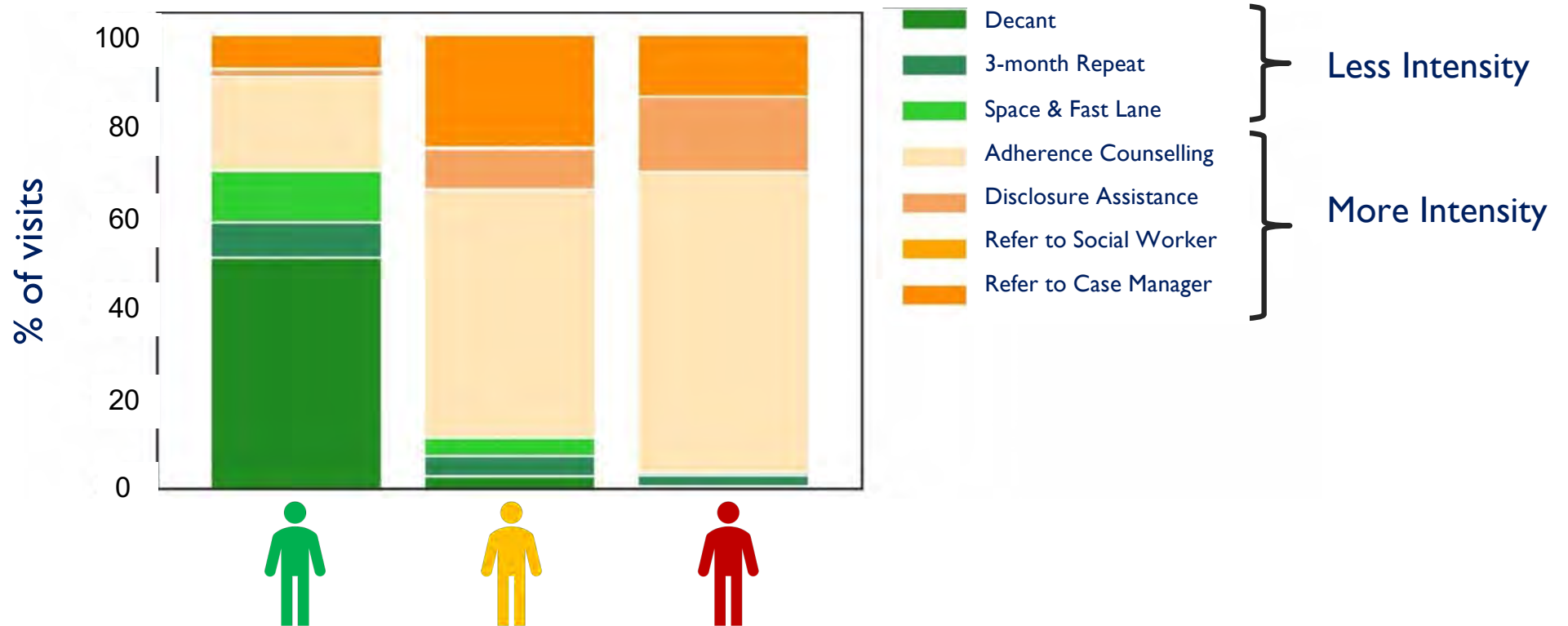
Uptake: HCWs completed ~30 per day, 2667 scorecards.

Acceptability: HCWs **agreed** with the scoring at 98% of visits

Autonomy: HCWs interventions were **nudged / guided** by score but not governed by prescription (tool can be overruled)

Practicality: The digital scorecards took median ~90 seconds to complete, whilst 20% took >5 min, suggesting **bi-model usage**

HCW intuitively prescribed differentiated models by risk profile



Healthcare workers reported richer conversations

- ✓ Enriched HCW-patient **conversations**
- ✓ Improved allocation **use of HCW time**
- ✓ **Empowered** HCWs taking tailored action
- ✓ Anecdotes of patient **agency** over their scores



Provider experience:



Sister Siphindile Lubisi

- Clinical Technical Officer, Mpumalanga
- Previously: DSD-Nurse, Nelspruit CHC

Dr Imke Engelbrecht

- Programme Manager RtC HQ
- Previously: PHC Medical Advisor, Ehlanzeni District

- How did having the scorecard impact/change the consultation?
- How did different patients perceive the score? How did you explain it?

[15 min]



Machine learning risk triaging synopsis

We've observed that:

- ✓ Enough data in existing HIV EMRs to repeatably segment risk groups
- ✓ Tools are feasible at the point of care
- ✓ HCW can use it to differentiate and improve care

What we still are working on:

- ? How facilities and implementers will adapt interventions
- ? Demonstrate impact on outcomes
- ? Capture time savings for HCW

Challenges for scaleup

Unrecognised potential: Resistance to increasing workload without realizing the potential for saving time on the majority of patients (green), yielding more time for red patients

HCWs may **prefer** to use existing methods (intuition, triaging by archetypes) or **may not trust** that an algorithm can understand patients

HCWs preferred the **digital** solution over a paper-based option, for convenience

Restrictive guidelines or IP programs may not allow HCWs to dynamically tailor care

Administrative burdens of reporting and inefficient filing systems may limit the benefit of reducing HCWs' workloads on low-risk clients

Not all risk levels or profiles have **mapped interventions** yet.

Data systems may not yet be able to keep up and take full advantage.