An SMS intervention to Improve HIV Linkage to Care: A Randomized, Comparative Effectiveness Trial

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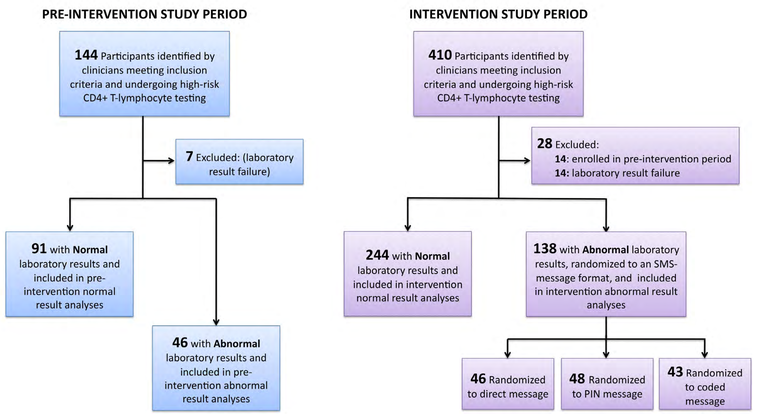
Background

- Up to 50% of HIV-infected persons in sub-Saharan Africa are lost from care between HIV diagnosis and ART initiation
- Structural barriers, including cost of transportation to clinic and poor communication systems, are major challenges
- Interventions to combat barriers to linkage to care are urgently needed
- **We evaluated the efficacy of an SMS-based lab result notification system combined with incentivized transportation reimbursements to improve linkage to care for high-risk HIV patients in rural Uganda**

Methods

- We enrolled adult participants in care at a PEPFAR-supported, publicly operated HIV clinic in Mbarara, Uganda
- Clinicians identified patients undergoing high-risk CD4 testing, defined as a test for which an abnormal result would prompt early return to care
- Participants enrolled in the pre-intervention period (January–August 2012) served as a control group
- **Participants enrolled in the intervention period (September 2012–November 2013) received an SMS message notifying them of normal results or, if results were abnormal, were randomized to one of three messages:**
  - **1) an SMS reporting an abnormal result (direct message)**
  - **2) a personal identification number-protected (PIN) SMS message**
  - **3) an SMS message reading "ABCDEFG", coded to convey an abnormal result confidentially**
- **Transportation reimbursements (~$6USD) were provided to those returning within 7 days of their first abnormal result SMS**

Figure 1. Consort Diagram of study participants



Statistical Analysis

- We fit survival analysis and Cox proportional hazards models among participants with abnormal laboratory results to estimate differences between groups for **outcomes of interest**:
  - 1) Time to clinic return after abnormal test result
  - 2) Time to ART initiation after abnormal test result if ART naïve
- Primary explanatory variables of interest were:
  - 1) Study period (pre-intervention vs. intervention)
  - 2) Message type (none, direct, PIN, or coded)
- Models were adjusted for: age, gender, district of residence, education, and CD4 result.
- The study was reviewed and approved by ethics committees at Partners Healthcare, Mbarara University of Science and Technology, and the Ugandan National Council of Science and Technology. All participants in the intervention group signed informed consent. The study was registered with clinicaltrials.gov (NCT NCT01579214)

Table 1. Characteristics of participants with abnormal CD4+ T-lymphocyte count laboratory results.

	Control Group (No SMS Message) (n=46)	Direct SMS Message Group (n=46)	PIN SMS Message Group (n=48)	Coded SMS Message Group (n=43)	*P*-value
Female gender (%)	47	52	54	52	0.75
Age (median, IQR)	37 (31 – 44)	31 (27 – 40)	30 (26 – 36)	30 (25 – 37)	0.001
Education (%)					0.85
<Primary	8	7	10	10	
Any primary	44	50	58	44	
Any secondary	31	28	19	35	
>Secondary	18	15	13	12	
ART Naïve (%)	56	85	73	72	0.03
Mbarara resident (%)	71	65	55	65	0.46
CD4 threshold, median (IQR)	350 (250 – 350)	350 (350 – 350)	350 (350 – 350)	350 (350 – 350)	0.01
CD4 result, median (IQR)	185 (106 – 262)	197.5 (115 – 277)	227 (89 – 308)	230 (137 – 282)	0.62
Days from laboratory result to clinic return, median (IQR) (n=183)	**34 (11 – 49)**	**4 (2 – 13)**	**11 (4 – 18)**	**6 (3 – 15)**	
Returned < 14 days (%)	**28**	**85**	**65**	**72**	**<0.001**
Days from laboratory result to ART initiation, median (IQR) (n=131)	**47 (11 – 75)**	**8 (3 – 19)**	**14.5 (6.5 – 22.5)**	**15 (5 – 20)**	
Initiated ART < 14 days (%)	**31**	**72**	**77**	**81**	**<0.001**

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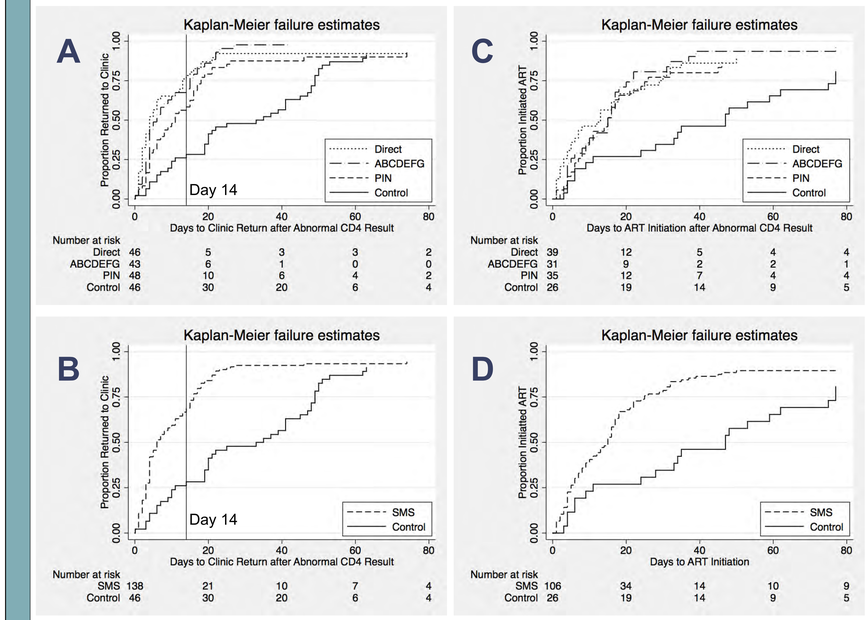
Table 2. Multivariable Cox proportional hazards estimates for hazard of time to return to clinic or time to ART initiation after an abnormal CD4+ T-lymphocyte laboratory test result†

	Hazard of Time to Clinic Return		Hazard of Time to ART Initiation	
Characteristic	**AHR (95%CI)**	**p-value**	**AHR (95%CI)**	**p-value**
Study group				
Control (no message)	REF	--	REF	--
Direct SMS message	**2.64 (1.62 – 4.31)**	**<0.001**	**1.65 (0.94 – 2.88))**	**0.08**
PIN SMS message	**2.13 (1.32 – 3.44)**	**0.002**	**1.56 (0.88 – 2.78)**	**0.13**
Coded SMS message	**3.15 (1.94 – 5.11)**	**<0.001**	**1.90 (1.08 – 3.34)**	**0.03**
Study Period				
Control (no message)	REF	--	REF	--
Intervention (any SMS)	**2.58 (1.71 – 3.89)**	**<0.001**	**1.71 (1.05 – 2.78)**	**0.04**

†Estimates adjusted for age, gender, educational attainment, residence within Mbarara, and CD4+ T-lymphocyte count result.

Figure 2. Kaplan-Meyer survival curves demonstrating time to clinic return after an abnormal CD4 count result (Panels A-B) and time to ART initiation after an abnormal CD4 count result (Panels C-D).

Time to Clinic Return | **Time to ART Initiation**



Conclusions

- An SMS-based laboratory result system coupled with transportation incentives significantly decreased time to clinic return and time to ART initiation after abnormal CD4 test results
- These findings should encourage larger effectiveness studies to further explore patient-centered, mHealth-based applications and financial incentive interventions to improve linkage to care in sub-Saharan African settings