Feasibility and Efficacy of Text-Messaging to Promote Care Among Trauma Patients Screened for HIV at an Urban Tertiary Emergency Department in Tanzania

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Original Research

Keywords: HIV, AIDS, SMS, Text Message, Reminder, Cell Phone, Opt-out, PITC, Trauma, Emergency Department, Tanzania

Posted Date: April 5th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-362653/v1

Version of Record: A version of this preprint was published at International Journal of Emergency Medicine on December 1st, 2021. See the published version at https://doi.org/10.1186/s12245-021-00395-0.

Abstract

Background

Due the high prevalence of Human Immune Virus (HIV), provider-initiated HIV testing for patients attending any health care setting is recommended. However, follow-up and linkage to care by those tested remains poor. We determined the feasibility and efficacy of text-messaging to promote follow-up among otherwise healthy trauma patients who underwent provider-initiated HIV testing and counseling at an Emergency Department (ED) in Tanzania.

Material and methods

This randomized controlled trial was conducted at Muhimbili National Hospital (MNH) ED between September 2019 to February 2020. Adult trauma patients consenting to HIV testing and follow-up text messaging were randomized to standard care (pre and post-test counseling) or standard care plus a series of 3 text-message reminders for follow-up in an HIV clinic, if positive, or retesting, if negative. Investigators blinded to study assignment called participants 2-months after the ED visit if HIV positive, or 4 months if HIV negative. We compared the proportion of people in the intervention and control groups completing recommended follow- up. Secondary outcomes were proportion accepting testing, agreeing to receive SMS and follow-up compliance by HIV status.

Results

Of 290 patients approached, 255 (87.9%) opted-in for testing and consented to the study. The median age of the study population was 29 [IQR 24-40] years. 127 (49.8%) were randomized to the intervention group and 128 (50.2%) to the control group. The short message service (SMS) system verified that 381 text messages in total were received. We traced 242 (94.9%) participants: 124 (51.2%) from intervention group and 118 (48.8%) controls. 100 (39.2%) subjects reported attending a follow-up visit, of which 77 (60.6%) were from the intervention group and 23 (17.9%) were controls. (RR = 3.4, 95%CI (2.3-5.0) resulting in number needed to treat (NNT) of 2.3. Of 246 HIV negative participants, 37% went for repeat-screening: 59% of those in the intervention group and 16% in the control group (RR= 3.7, P =<0.0001, NNT 2.3). Among 9 positive patients, all 5 in the intervention group and 3 of 4 controls had follow-up visits.

Conclusion

Automated text message is a feasible and effective way to increase follow up in HIV tested individuals in a limited income country.

Background

HIV continues to be a major global public health problem, claiming more than 35 million lives thus far. In 2017, 940 000 people died from HIV-related causes globally (1). Sub-Saharan Africa including Tanzania is the most affected region, with 25.8 million people living with HIV in 2017. The Sub-Sahara accounts for

two-thirds of the global total of new HIV infections (2). In 2016, 1.4 million people were living with HIV in Tanzania. This equates to an estimated HIV prevalence of 4.7% (3).

It has been shown that via provider-initiated /opt-out testing, people living with HIV/AIDS can be identified earlier and enrolled into care, reducing mortality (4–6). In Tanzania, the national comprehensive guideline for HIV testing and counseling of 2017 recommends routine testing and screening for HIV/AIDS in all health centers (6). Testing is not enough; mortality and morbidity is reduced by appropriate follow up services, however, follow up is poor in these patients once tested (5, 7, 8). Failure to attend medical appointments among persons living with human immunodeficiency virus (HIV) has been associated with poor health outcomes (9, 10).

Text message via Short Message Service (SMS) is a potential intervention for improving follow up and compliance with recommended care, providing medication and appointment reminders and which can improve compliance and retain patients in care (7, 8, 11–17). Studies on feasibility and efficacy of using text message via SMS in promoting care have been done in many countries; almost all have shown an improvement in health care behaviors and disease outcome (7, 8, 11–17). Nevertheless, there are few studies on the feasibility and effectiveness of using SMS as a means to promote care sub-Saharan Africa and none in Tanzania (7, 8, 15).

The Muhimbili National Hospital - Emergency Department (MNH-ED) recently created a protocol for rapid HIV testing of trauma patients. Trauma patients are otherwise healthy and would not have undergone HIV testing in another setting. A pilot study in our ED found that of those who were HIV positive, only half followed up for care (6). We therefore tested the feasibility and efficacy of using automated text-messaging to promote follow-up care among otherwise healthy trauma patients screened for HIV at the MNH- ED.

Methodology

Study Design

This was a single centre randomized, blinded controlled trial of adult trauma patients presenting to the Emergency Department of Muhimbili National Hospital between September 2019 and February 2020 who agreed to provider-initiated, rapid HIV testing.

Study Setting

Muhimbili National Hospital (MNH) is a tertiary referral hospital with a level 1 trauma center located in Dar es Salaam, Tanzania. The hospital has a bed capacity of 1500 with around 1000 to 1200 admissions per week, operating 24hrs in 7 days of the week. The MNH-ED is the first public ED in the country and was opened in 2010 (18). It is staffed with emergency physicians, postgraduate students in an emergency medicine training program, medical officers, critical care nurses and nursing officers. The MNH-ED is the entry point to the hospital for most of the patients attending MNH and sees around 200 patients daily

with an admission rate of 65%. Acutely ill patients are received at ED, resuscitated and stabilized before being disposed to the appropriate ward.

Participants

We included all adult patients with trauma attending MNH-ED who agreed to be tested for HIV and were willing and able to receive text messages on their mobile phones. We excluded patients below 18yrs, patients with GCS below 15, patients with known HIV with evidence of either a treatment card or medications, clinically unstable patients, patients who didn't own a cell phone or phone was not capable of receiving an SMS, and patients previously enrolled in the study.

Study Protocol: The study is registered in the Pan Africa Clinical trial Registry (https://pactr.samrc.ac.za/TrialDisplay.aspx?TrialID=9402) on 09/20/2019 with the trial registration number PACTR201909858930669. Researchers actively walked through the ED to identify trauma patients. We also used the tracking board of the ED's electronic medical record (Wellsoft$^{TM)}$ to identify patients triaged with the complaint related to trauma. Researchers screened patients for eligibility and willingness to be HIV tested and receive text messages. They then consented the patients to the study. Research assistants captured baseline patient data using a structure case report form ; data was then transferred to an online data storage platform (RedcapTM) and later to the Extrateq™ automated SMS dispatch program. A trained nurse provided pretest and posttest counselling to all patients tested for HIV. Standard trauma treatment was performed at the discretion of the treating physician.

Randomization and Blinding

Prior to beginning enrollment,, we created a computer-generated randomization list that ensured equal numbers of participants in the intervention and control groups. (19). We used this randomization schedule to assign patients to the intervention or control groups once they consented, prior to testing them at the ED. There was allocation concealment i.e., research assistants (data collectors and data entry personnel) knew that the patient was assigned to group A or B (representing control or intervention) but did not know which was the control or intervention group.

Intervention: We used an automated SMS programmed system to send texts to the patients in the intervention arm. The randomization scheme was programmed into this SMS portal, which then ensured that SMS messages were sent only if the patient had been randomized in the intervention arm of the study. We verified that the computer was able to generate SMS and notify all participants in the intervention group; The program was set to deliver text messages 3 times for each individual in the intervention group, each week for HIV positive patients and each month for HIV negative patients from the day of visitation. SMS content was sent in Swahili with an English translation reading: "Dear EMD client, this is a reminder that's is important for your health that you visit the nearest hospital to you, thank you in advance and have a good day.

Follow-up

Follow up phone calls were made by research assistants or the primary investigator 2 months or 4 months after the ED visit depending on whether the subject was HIV positive or negative, respectively. The researchers making the calls were blinded to the arm of the study the patient was in. All traced participants were asked during the follow up phone call whether they received a message at least once and to report whether they attended their follow up CTC clinic (if HIV+) or went for repeat HIV screening (if HIV-). Those who were not traced were considered lost to follow up. Follow up data was entered into the patient's initial questionnaire and subsequently uploaded to the data storage platform.

Outcomes

The primary outcome was the proportion of patients who self-reported attending follow up visits either to the CTC clinic or for repeat HIV testing.. Based on a previous study by *Mugo et al* (8) where compliance in the intervention and control groups was 59% and 41% respectively, we determined the minimum sample size required was 240 (120 in each group. Secondary outcomes were the proportion of patients who were eligible and agreed to be in the study, the proportion of positive and negative results, the proportion of HIV positive who have had initial CTC visit, and the proportion of HIV negative patients who had repeat testing at 3 months.

Data Analysis and statistical methods

Data was coded and imported into Research Electronic Data Capture (REDCap). Statistical Package for Social Science (IBM SPSS version 25, IBM, LTD, Carolina, USA) was used for analysis. Relevant frequencies and tables were generated for all variables. Means/proportions and medians/interquartile ranges were calculated for continuous variables as appropriate to their distribution The primary outcome was the difference in the proportion of patients who had appropriate follow-up in each arm of the study. This was compared using Pearson's Chi-square test and the difference shown using Relative risks (RR) with 95% confidence intervals (CI) and number needed to treat (NNT). The secondary outcomes were compared using Pearson's Chi- Square test and difference shown by RR as above, or Fishers Exact test and proportions/means was used in to report secondary outcomes. Statistical analysis was two-tailed, and a *p*-value of less than 0.05 was considered statistically significant. An intent to treat analysis was used to arrive at our results.

Results

Recruitment and Baseline Characteristics of Study Population

During the study period, a total of 1804 adult trauma patients were seen in the MNH-ED. Of these patients, 70.7% were excluded due to severe injuries with instability **(Figure 1)**. The remaining were consecutively screened (N=529) and 290 met screening criteria. Of these, 255 (87.9%) consented to have an HIV test and participate in the study. Reasons for not participating were most commonly stress from the traumatic experience of being involved in an accident and not being emotionally ready to deal with any more stress

if the results of the HIV test were positive. Of the 255 enrolled patients, we achieved phone follow-up for 242 (94.8%) patients.

The majority of participants were male (83%), and most participants were young adults with median age of 29 years with IQR 24-40 years **(Table 1).** Approximately half were married with the majority (82.4%) having primary education as highest educational level achieved. Most of the study population were referred from outside hospitals, and 85% of the study population had no health care insurance. The majority of participants were employed by others (i.e., hired staff, 60.4%). Of those enrolled, 9 (6%) tested HIV positive.

There were 128 (50.2%) participants in the control group and 127 (49.8%) in the intervention group. (**Figure 1**). There were more males in intervention group and more females in control group. More of the elderly participants were randomized into the intervention arm **(Table 1**). There were 5 positive and 122 negative patients in intervention group and 4 positive and 124 negatives in control group.

Compliance with Follow-up for Recommended Care.

A total of 242 (94.9%) participants were reached by phone in follow-up. Among the 13 (5%) that were lost to follow up, 3 were in the intervention group and 10 in the control group. All interventional group participants traced reported to receive the message at least once with all control group individuals denying it.

Among the 242 reached, 100 (41.3%) participants self-reported they completed follow-up care according to their respective HIV status; 77% of those who completed care were in the intervention group and 23% in the control group **(Table 2).** (P = <0.0001). Relative risk (RR) for attending follow up care was 3.4 (CI 2.3 -5.0). The number of patients needed to treat (NNT) with SMS to obtain one follow-up visit in the study population was 2.3**.** (95% CI 3.1- 1.9)

Compliance to Follow up by HIV status

In the HIV negative population, the follow up rate for repeat screening was 37.4%. The proportion who underwent repeat screening was significantly higher in the intervention group compared to the control group (59.0% vs 16.1% respectively, P<0.0001). Compared to no intervention after the ED visit, sending a text message increased the likelihood of follow-up with a RR = 3.65 among HIV negative patients and NNT = 2.3 (95% CI 3.1 -1.9) **(Table 2)**

All 9 patients who were HIV+ were reached by the study investigators. 8 out of 9 (88.9%) reported to have attended their initial CTC visit. All 5 in the intervention group had attended their initial CTC visit and 3 out of 4 in the control group reported to do the same. Numbers were too small for testing of significance. (**Table 2).**

Discussion

This randomized controlled trial (RCT) tested the feasibility and efficacy of text-messaging to promote follow-up care among otherwise healthy trauma patients screened for HIV at an Emergency Department in a limited income country. We found that most patients approached were willing to be tested and receive SMS messages. Follow up with recommended care was significantly greater in those who received the text messages compared to those who did not, RR= 3.4.

Previous studies globally evaluating the effect of SMS in promotion of patient care not only in HIV but other illnesses have also found this method to improve compliance with care (7,8,11–17). A 2017 systemic review by *Daher et al* including 99 studies in Africa, Asia, Europe and America assessed whether digital innovations were feasible, acceptable and had a general impact on promotion of care in HIV and other sexual transmitted diseases. The review concluded that not only were these innovations feasible, but they were also acceptable and had general impact in promotion of care (13). Likewise, in our study we were able to verify that SMS intervention does significantly increase follow up visits in patients screened for HIV. A 2017 meta-analysis by *Fontelo et al* which analysed 34 different studies globally, showed that text message was a valuable tool to increase general HIV related compliance not only in attendance but also in medication and adherence (14). All of the studies in these reviews involved symptomatic patients.

Our study had a number of unique aspects. While prior RCT's have been conducted using digital interventions like text message via SMS to improve the care of HIV patients in LMIC countries (7,8,10,15), most of these studies were confined to patients known to have or suspected to have HIV due to symptoms, while our study assessed the value of this intervention in asymptomatic patients who had not sought out HIV screening. This study also looked at the impact of SMS on individuals testing negative for HIV and found that the SMS was helpful in compliance with repeat testing in three months. A Kenyan study by *Mugo et al* (8) comparing the impact of text message, phone call and in-person appointment reminders on rate of repeat screening of HIV also found that text message increased likelihood of accessing follow up services. However, that study included only patients who had presented to a clinic because of their medical symptoms.

Another unique aspect of our study was the use of pre-programmed, automated SMS. advantage of automated SMS is that messages can be programmed to be sent to specific individuals at specified times. The intervention does not require an individual to remember or physically send these messages since the computer programme does this. The intervention had high fidelity: 381 messages were logged as sent, participants in the intervention arm remembered receiving a message, and no patients in the control arm reported receiving the SMS.

This study also shows the importance of provider-initiated counselling and testing for every patient entering the hospital in our study. Among patients without medical complaints, and who would have not presented to a medical facility other than for trauma, we found an incidence of HIV of 3.5%. This is substantially higher than in many ED-based screening programs in high income countries. While we only included patients who were willing to be tested for HIV, the cohort study by *Ramadhan et al* (5) at our

emergency department enrolled participants first, and then asked if they were willing to be tested and receive their results. In that study, 250 (76.7%) patients accepted testing for HIV, and among them 98.8% were ready to receive their test results, demonstrating again the willingness of people who are asymptomatic to be tested.

The success of this intervention in Tanzania can be explained by the wide availability of mobile phones in limited and middle-income countries which has allowed communication even in remote areas. The use of SMS (as opposed to email) meant that patients did not need to have internet access or incur any cost to receive the messages, eliminating the burden of buying internet data packages. All of the participants when asked if they would be okay with receiving an SMS accepted, showing the method is acceptable to most individuals.

A total of $20,000 was used in research tool development and $170 used for domain name registration, sending messages and hosting the research app online. The number needed to treat suggests this is a small cost compared to the cost the individual and government will incur to treat advanced HIV or AIDS and its opportunistic infections. Used broadly, this type of technology would have significant impact on the transmission and treatment of HIV.

The overall rate of follow up for care in our cohort was 39.2%, which is certainly suboptimal. This shows the need for some type of intervention to increase compliance with care. Follow up was significantly higher in the intervention group compared to control group overall. The majority of the patients were HIV negative and were much more likely to follow up for repeat screening if they received the SMS than if they were in the control group. HIV positive patients had good follow up in both groups, but with only 9 people in the total group, the uncertainty surrounding the impact of the intervention in those who are HIV+ is quite large. We would recommend that the Ministry of Health, Community Development, Gender, Elderly and Children plus the Government and other stakeholders as a whole should look at employing and funding SMS based innovation as means to remind patients of important follow up visits not only in HIV but other chronic diseases

4.2) Study Limitationsand Mitigation

Our assessment of following up with recommended care was based on self-report. Self-reporting can be affected by social desirability bias. However, we would not expect the intervention group to be more likely to provide positive answers than control group. Secondly it was a single center study, our results may not be generalizable to other hospitals in Tanzania. However, Muhimbili National hospital is a tertiary level referral hospital, receiving patients from all over the country. And lastly, the small number of HIV positive participants prohibited useful statistical testing on the effect of the intervention in this group.

In conclusion, text message is a feasible and efficient way to increase follow up visits among individuals tested for HIV in a limited income country. This study was able to show a very significant difference between the groups that receive reminder text to those that don't. This relatively low-cost method can help in decreasing the burden of disease from HIV in LMIC's, as well as other chronic illnesses.

Abbreviations

AIDS Acquired Immune Deficiency Syndrome

ART Antiretroviral Treatment

CTC Care and Treatment Clinics

ED Emergency Department

EMD Emergency Medical Department

GCS Glasgow Coma Scale

IRB Institutional Review Board

SPSS Statistical Package For Social Science

HIV Human Immunodeficiency Virus

MNH Muhimbili National Hospital

MUHAS The Muhimbili University of Health and Allied Sciences

PITC Provider Initiated Testing and Counselling

SMS Short Message Services

WHO World Health Organization

Declarations

Competing Interest: The authors declare that they have no competing of interest

Ethical Approval and Consent: Permission to conduct the study was sought from relevant ethical committees at Muhimbili University of Health and allied Sciences (MUHAS) and Muhimbili National Hospital (MNH) Research committee. All patients entered into the study after informed consent was signed. All patients received treatment as per standard hospital policies. The data obtained during the study was kept anonymous.

Consent to Publish: Not applicable

Availability of data and Material: The dataset supporting this conclusion is available from author on request.

Funding: Non funded project, the principal investigators used their own funds to support data collection and logistics.

Authors contribution: GMH conceived the idea and design of the study, acquired, analyzed and interpreted the data, and drafted original manuscript and revised the manuscript. HRS contributed to conception and design of the study, data acquisition, entry, validation, and analysis and also critically revised the manuscript. EW contributed to the design of the study, data validation, and analysis and also critically revised the manuscript. SK contributed to data validation, review and analysis and also revised the manuscript. JM contributed to the data review and analysis. RM contributed to the data validation, review and analysis. SR contributed to the data review and analysis. WM contributed data validation, review, analysis. FS contributed to data analysis and review. MG contributed to data validation and review. All authors contributed to conception and design of the study, data validation, review, analysis and also critically revised the manuscript. All authors read and approved the final manuscript.

Acknowledgement: Authors would like to acknowledge all study participants, The Karuma family for their assistance in making this project successful without forget all friends and family who prayed for my success.

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Tables

TABLE 1: Demographic characteristics of study population

Demography Characteristic	Total N = 255	Control Group Count (%) N = 128	Intervention Group Count (%) N = 127
Sex	-	-	-
Male	211	48.8%	51.2%
Female	44	56.8%	43.2%
Age Groups			
18-35years	175	52.6%	47.4%
36-55 years	64	50.0%	50.0%
>55 years	16	25.0%	75.0%
Marital status			
Divorced	11	45.5%	54.5%
Married	144	50.7%	49.3%
Single	97	50.5%	49.5%
Widowed	3	33.3%	66.7%
Level of education			
College	27	44.4%	55.6%
Informal	10	40.0%	60.0%
Primary	139	49.6%	50.4%
Secondary	74	52.7%	47.3%
University	5	80.0%	20.0%
Occupation			
Employed	154	46.8%	53.2%
Student	5	20.0%	80.0%
Unemployed	89	58.4%	41.6%
Unskilled Labor	7	42.9%	57.1%
Insurance status			
Insured	38	42.1%	57.9%
Noninsured	217	51.6%	48.4%

Referral Status			
Referral	210	50.0%	50.0%
Non referral	45	51.1%	48.9%
HIV status			
Negative	246	50.4%	49.6%
Positive	9	44.4%	55.6%

Table 2: Follow up visits according to treatment Arm

	N	Total follow up services in all study patients N (%)	P value
Standard counseling plus SMS	127	77(60.6%)	<0.0001
Standard counseling alone	128	23(17.9%)	
*RR 3.4 (CI 2.3 -5.0), NNT 2.3 (95% CI 3.1- 1.9)			
	N	Repeated HIV screening in HIV negatives N (%)	P value
Standard counseling plus SMS	122	72 (59.0%)	<0.0001
Standard counseling alone	124	20(16.1%)	
*RR 3.7 (CI 2.4 -5.6), NNT 2.3 (95% CI 3.1 -1.9)			
	N	Follow up visit to CTC in HIV positives N (%)	Fisher Exact Probability
Standard counseling plus SMS	5	5(100%)	0.444

Figures

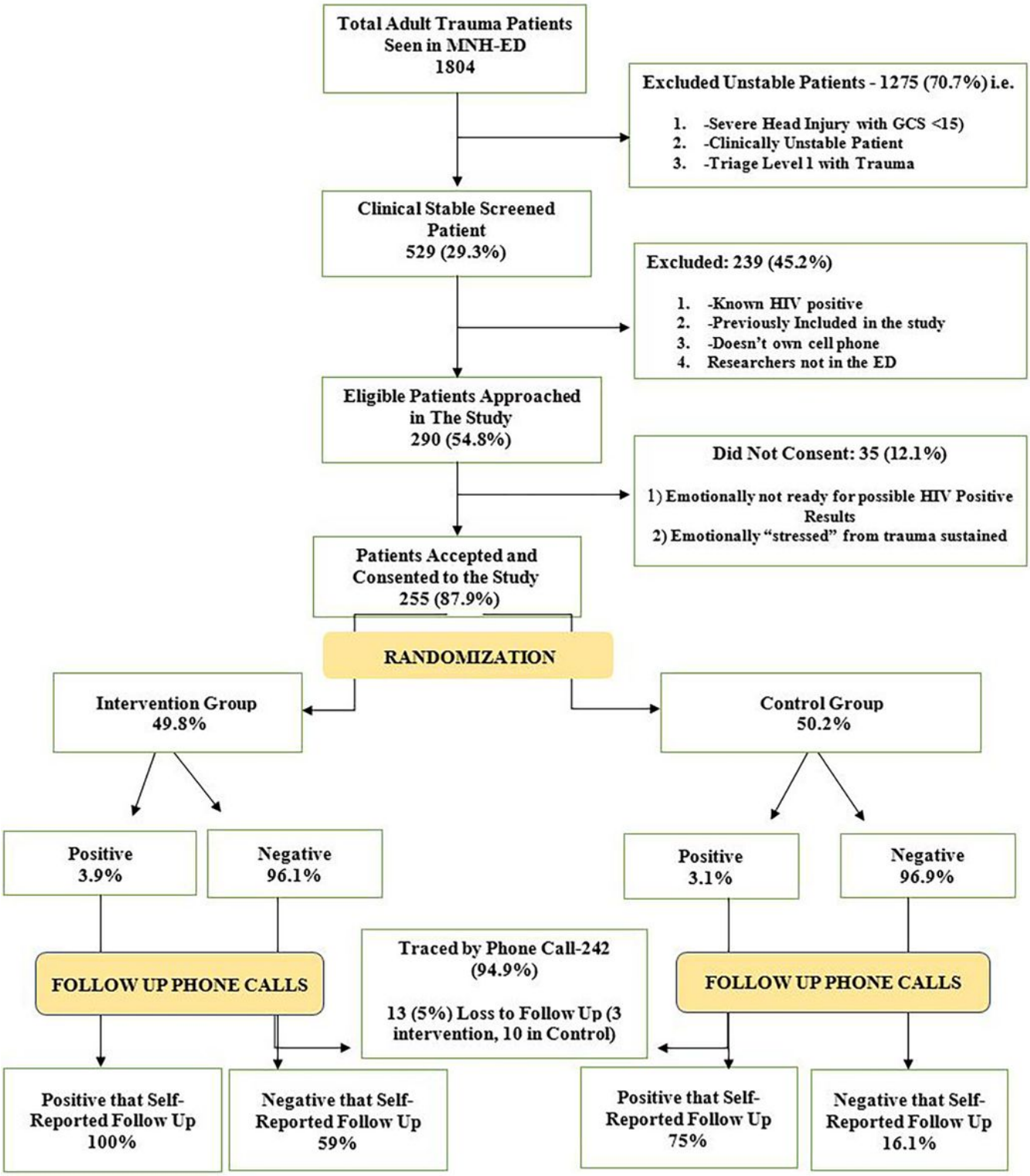

Figure 1

PARTICIPANT FLOWCHART.