IMPACT OF REMINDER MODULE ON ADHERENCE AND TREATMENT OUTCOMES AMONG HIV- POSITIVE PATIENTS ON ANTIRETROVIRAL THERAPY IN HOSPITAL SUNGAI BULOH, MALAYSIA

SURAJUDEEN ABIOLA ABDULRAHMAN

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By

SURAJUDEEN ABIOLA ABDULRAHMAN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Doctor of Philosophy

October 2015

DEDICATION

This work is dedicated to my beloved wife Maarufat Olaide Olaosebikan and daughters Haneefah Oyindamola Abdulrahman and Hannan Desola Abdulrahman.

Abstract of thesis presented to the senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy.

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October 2015

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Introduction: Adherence to treatment remains the cornerstone of long term viral suppression and successful treatment outcomes among patients receiving antiretroviral therapy (ART). According to WHO, minimum adherence levels of 95% are required for treatment success. Poor adherence to treatment (clinic visits and medication adherence) remains a stumbling block to the success of treatment programs and generates major concerns about possible resistance of the HIV virus to the currently available ARVs. The objective of this study was to evaluate the impact of a mobile phone reminder module on adherence and treatment outcomes among HIV positive patients on ART in Malaysia.

Methods: A single-blinded, parallel group randomized controlled trial conducted in Hospital Sungai Buloh, Malaysia in which 242 Malaysian patients were randomized to intervention or control groups was conducted between January and December, 2014. Intervention consisted of a reminder module delivered through SMS and telephone call reminders by trained research assistants for 24 consecutive weeks, in addition to adherence counseling at every clinic visit. Data on adherence behavior of patients was collected using specialized, pre-validated *Adult AIDS Clinical Trial Group* (AACTG) adherence questionnaires. Data on weight, clinical symptoms, CD4 count and viral load tests were also collected. Data was analyzed using SPSS version 21 and R software. A 5% level of statistical significance was considered for all analysis. Repeated measures ANOVA, Friedman's ANOVA and Multivariate regression models were used to evaluate efficacy of the intervention as well as to establish the relationship between the independent (predictors) and outcome variables.

Results: The response rate after 6 months follow up was 93%. There were no significant differences at baseline in gender, employment status, income distribution and residential location of respondents between the intervention and control group. After 6 months follow up, the mean adherence was significantly higher in the intervention group as compared to the control group. The proportion of respondents

who had good (>95%) adherence was significantly higher in the intervention group. A significantly lower frequency in missed appointments (p=0.001), lower viral load (p=0.001), higher rise in CD4 count (p=0.017), lower incidence of tuberculosis (p=0.001) and OIs (p=0.001) at 6 months follow up, was observed among patients in the intervention group. We found that both medication adherence and clinic attendance significantly predicts immunological and virological outcomes of antiretroviral therapy.

Conclusion: The findings of the current study indicates that mobile phone reminders are effective in improving adherence (clinic attendance and medication adherence) and treatment outcomes (immunological and virological) among HIV positive patients on ART. The ubiquitous nature of mobile phones even among HIV positive patients from low to middle income countries provides an excellent platform for targeted health interventions, irrespective of the nature of the epidemic, whether concentrated or generalized. Since the success of ART programs is largely measured by retention on treatment, the potential effects of this intervention in tracking patient's clinic attendance and ensuring that they are retained in care remains of immense value in HIV programming.

Keywords: Mobile phone reminders, HIV, adherence, antiretroviral therapy, treatment outcomes

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah.

KESAN MODUL PERINGATAN BAGI MENINGKATKAN PEMATUHAN DAN HASIL RAWATAN DI KALANGAN PESAKIT POSITIF HIV YANG MENJALANI TERAPI ANTIRETROVIRAL DI HOSPITAL SUNGAI BULOH, MALAYSIA

Oleh

SURAJUDEEN ABIOLA ABDULRAHMAN

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Pengenalan: Kepatuhan kepada terapi adalah asas kepada supresi virus secara jangka panjang dan kejayaan terhadap terapi antiretroviral (ART). Menurut WHO, tahap pematuhan minimum sebanyak 95% diperlukan bagi kejayaan rawatan. Kepatuhan yang lemah terhadap rawatan (lawatan klinik dan pematuhan pengubatan) masih menjadi penghalang kepada kejayaan program rawatan serta melahirkan kebimbangan yang tinggi tentang kemungkinan kerintangan terhadap virus HIV dengan menggunakan ARV yang sedia ada. Objektif kajian ini bertujuan untuk menentukan keberkesanan telefon mudah alih (peringatan SMS dan panggilan telefon) dalam meningkatkan kepatuhan (kehadiran klinik dan pematuhan pengubatan) dan hasil rawatan di kalangan pesakit HIV yang menjalani ARV di Malaysia.

Kaedah: Satu percubaan klinikal terkawal secara rawak, kumpulan selari dan buta tunggal yang melibatkan 242 berwarganegara Malaysia, pesakit positif HIV yang menjalani terapi antiretroviral telah dijalankan di antara bulan Januari hingga Disember, 2014. Campur tangan terdiri daripada modul peringatan dihantar melalui SMS dan panggilan telefon peringatan pembantu penyelidik dilatih selama 24 minggu berturut-turut, selain menganut kaunseling di setiap lawatan klinik. Data tentang faktor sosiodemografi, gejala klinikal dan pematuhan tingkah laku responden dikumpulkan menggunakan borang soal selidik yang khusus iaitu *Adult AIDS Clinical Trial Group* (AACTG) yang diubah suai dan disahkan terlebih dahulu. Kiraan CD4, beban virus, berat badan, simptom klinikal juga dijalankan dan direkodkan. Data dianalisa dengan menggunakan SPSS versi 21 dan perisian R. Nilai-p < 0.05 dianggap signifikan dari segi statistik. Repeated measures ANOVA, Friedman's ANOVA dan model regresi multivariat digunakan untuk mengkaji keberkesanan intervensi serta menentukan perkaitan antara pemboleh ubah bebas dan pemboleh hasil.

Keputusan: Kadar tindak balas selepas 6 bulan susulan adalah 93%. Tiada perbezaan yang ketara di peringkat asas dari segi jantina, status pekerjaan, pendapatan, dan lokasi

kediaman dalam kumpulan campur tangan dan kumpulan kawalan. Selepas susulan daripada 6 bulan, pematuhan purata didapati meningkat di kalangan kumpulan campur tangan berbanding dengan kumpulan kawalan. Peratusan responden dalam kumpulan campur tangan juga didapati mempunyai kepatuhan yang baik (> 95%) pada 6 bulan susulan. Terdapat kekerapan yang rendah dan kepentingan pembolehubah seperti pelantikan terlepas (p = 0.001), beban virus rendah (p = 0.001), tahap kiraan CD4 tinggi (p = 0.004), insiden yang lebih rendah daripada batuk kering (p = 0.001) dan OI (p = 0.001) pesakit dalam kumpulan campur tangan. Kami mendapati bahawa kedua-dua pematuhan kepada rawatan dan kehadiran klinik ketara boleh meramalkan hasil imunologi dan virologi terapi antiretroviral**.**

Kesimpulan: Dapatan kajian ini menunjukkan peringatan telefon mudah alih berkesan untuk meningkatkan kepatuhan (rawatan dan ubat) dan hasil rawatan (imunologi dan virologi) dalam kalangan pesakit HIV positif yang menjalani ART. Sifat sentiasa ada telefon mudah alih walaupun dalam kalangan pesakit HIV positif daripada negara berpendapatan rendah dan sederhana menyediakan platform terbaik untuk penambahbaikan kesihatan terarah tanpa mengira epidemik sama ada tertumpu mahu pun menyeluruh. Oleh sebab kejayaan program ART bergantung pada tempoh rawatan, potensi penambahbaikan ini dalam menjejak kehadiran pesakit menerima rawatan dan memastikan mereka terus dijaga adalah sesuatu yang bernilai dalam merawat HIV.

Kata kunci: Peringatan telefon bimbit, HIV, pematuhan, terapi antiretroviral, hasil rawatan

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Surajudeen A. Abdulrahman

This thesis was submitted to the senate of the Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory committee were as follows:

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This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
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LIST OF ABBREVIATIONS

ART	Antiretroviral Therapy
ARV	Antiretroviral
AACTG	Adults AIDS Clinical Trial Group
ABC	Abacavir
AIDS	Acquired Immune Deficiency Syndrome
ALT	Alanine Transaminase
ALP	Alkaline Phosphatase
ANOVA	Analysis of Variance
ATV/r	Atazanavir/ritonavir
AZT	Zidovudine
BP	Blood Pressure
CDC	Centers for Disease Control
CD4	Cluster of Differentiation 4
CD8	Cluster of Differentiation 8
CI	Confidence Interval
CONSORT	Consolidated Standards of Reporting Trials
DBP	Diastolic Blood Pressure
DNA	Deoxyribonucleic Acid
DOTS	Directly Observed Therapy Shortcourse
DRV	Drunavir
DRV/r	Drunavir/ritonavir
d4T	Stavudine
EDA	Exploratory Data Analysis
EFV	Efavirenz
FBC	Full Blood Count
FET	Fisher's Exact Test
FTC	Emtricitabine
HAART	Highly Active Antiretroviral Therapy

HAPA	Health Action Process Approach
HBM	Health Belief Model
HBV	Hepatitis B Virus
HBsAg	Hepatitis B surface Antigen
HIV	Human Immunodeficiency Virus
HIV-1	Human Immunodeficiency Virus – 1
HIV-2	Human Immunodeficiency Virus – 2
HTC	HIV Testing and Counselling
IDU	Injecting Drug Use/User
LFT	Liver Function Test
LTFU	Lost-to-follow-up
LPV/r	Lopinavir/ritonavir
MAC	Malaysia AIDS Council
MEMS	Medication Events Monitoring System
mmHg	Millimeter Mercury
MSM	Men who have sex with men
NIH	National Institute of Health
NNRTI	Non-nucleoside Reverse Transcriptase Inhibitor
NRTI	Nucleoside Reverse Transcriptase Inhibitor
NVP	Nevirapine
OI	Opportunistic Infection
OR	Odds Ratio
PCV	Packed Cell Volume
PCP	Pneumocystis Carinii Pneumonia
PI	Protease Inhibitor
PLHIV	People Living with HIV
PML	Progressive Multifocal Leukoencephalopathy
PMT	Protection Motivation Theory
PMTCT	Prevention of Mother to Child Transmission
RCT	Randomized Controlled Trial

RM	Ringgit Malaysia
RNA	Ribonucleic Acid
SBP	Systolic Blood Pressure
SD	Standard Deviation
SGPT	Serum Glutamic Pyruvic Transaminase
SMS	Short Message Service
SPSS	Statistical Package for Social Sciences
STI	Sexually Transmitted Infection
SQV/r	Saquinavir/ritonavir
TB	Tuberculosis
TDF	Tenofovir
TMC	Transtheoretical Model of Change
TPB	Theory of Planned Behaviour
UK	United Kingdom
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNICEF	United Nations Children Fund
UPM	Universiti Putra Malaysia
USA	United States of America
VAS	Visual Analogue Scale
VMS	Visual Medication Schedule
WHO	World Health Organization
ZDV	Zidivudine
3TC	Lamivudine

This chapter provides a brief overview on the background of the study, its objectives

CHAPTER 1

INTRODUCTION

This chapter provides a brief overview on the background of the study, its objectives, problem statement, research questions as well as the significance of the study. The research hypotheses and conceptual framework are also explicitly itemized.

1.1 Background

The first case of Acquired Immune Deficiency Syndrome (AIDS) was reported in 1981 among homosexual men in the United States. In 1983, its causative agent, the Human Immunodeficiency Virus (HIV), was identified. Shortly afterwards (mid-1980s), some evidence emerged to show how slowly over time the virus had spread unnoticed to several parts of the world. Several distinct epidemics characterize this globally devastating pandemic, each with their peculiar origin, with regards to geographical spread and population groups affected, and often consist of variations in frequencies and types of risk behaviours and practices, such as sharing drug injection equipment or engaging in unprotected, casual sex with multiple partners (United Nations/WHO, 2003). Since then, the epidemic has taken generalized, concentrated or low epidemic proportions within and between populations in different countries, with sub-Saharan Africa being worst hit.

Already, over 30 million deaths from AIDS-related diseases have been recorded globally (United Nations, 2011). 2.3 million new infections, and 1.6 million deaths from AIDS-related causes were reported among men, women and children in 2012 alone. As at 2012, the number of persons living with HIV globally stood at 35.3million (UNAIDS, 2013).

Greater diversity in the AIDS pandemic has been observed in Asia compared to Africa. Because Asia accounts for about 50% of the world's population, apparently minimal differences in the infection rates could translate to enormous increase in the absolute number of people infected. "The total number of people living with HIV (PLHIV) in Asia and the Pacific is thought to be about 4.9 million" (UNAIDS, 2013). About 50% (2.4 million) of these were in India, 15% (740,000) in China, 11% (530,000) in Thailand, 5% (240,000) in Myanmar and only about 1.9% (93,000) in Malaysia (UNAIDS, 2010). With the exception of Thailand, almost all other Asian countries have a national prevalence of less than 1% among their adult populations. However owing to very large population sizes in some of the countries in this region, infection rates and patterns in some smaller provinces and states may be masked by national averages. For example, more than 50% of people living with HIV in China are from five provinces (UNAIDS, 2011).

Men who have sex with men, injecting drug users, sex workers and their partners constitute the most-at-risk groups in many Asian countries. However, an evolution from a concentrated to a generalized epidemic has been witnessed in these areas lately. Thailand, among other Asian countries responded rapidly to the epidemic with extensive multi-sectoral campaigns to educate the public and prevent the spread of HIV through multiple simultaneous approaches to HIV prevention – and have succeeded in reducing the prevalence. "Other very populous regions, such as China, have only recently admitted that the spread of HIV threatens their populations, and as a result their prevention work is lagging behind the spread of the virus" (UNAIDS, 2011).

In Malaysia, the first case of HIV was diagnosed in 1986. "By the end of 2013, there was a cumulative figure of 101, 672 HIV cases reported to the Ministry of Health, 20, 235 AIDS cases, and 16, 340 deaths, thus leaving the reported figure of 85, 332 as those living with HIV" (Malaysia 2014 Global AIDS Response Country Progress Report). In 2002, the epidemic peaked with a rate of 28.5 per 100,000 population. Subsequently, a steady decline achieved at a rate of 12.8 per 100,000 population was observed in 2010 (Malaysia National Strategic Plan, 2011-2015). By 2011, the number of persons living with HIV/AIDS increased to 81,000 with 3, 479 new infections in the same year, showing a gradual decline from the 2002 figure of 6, 978. In 2013, there were 3, 393 new infections reported to the Ministry of Health. Cumulative AIDS death in 2009 was estimated at 5,800 (4, 500 – 7,200). The country has an overall prevalence of 0.5% as at 2012.

Notwithstanding the concentrated nature of the HIV/AIDS epidemic in Malaysia among most-at-risk groups like IDUs, MSMs, female sex workers and transgender people, there is increasing evidence that overlapping of injecting drug use and risky sex behavior is occurring, with a resultant amplified HIV infection rates between the different populations. Against the background of IDU being the key driving factor earlier on, the implementation of harm reduction programmes since 2005 has resulted in a significant decline in the number of HIV infections through needle sharing. "In 2011, sexual transmission has superseded IDU as the key driving factor of the epidemic with a ratio of 6 sexual transmissions for every 4 IDU reported" (Malaysia 2012 Global AIDS Response Country Progress Report).

Males constitute majority (78.5%) of cumulative HIV cases in Malaysia. Amongst men, the major routes of infection reported in 2013 were injecting drug use (21.5%) and sexual transmission (73.6%). Likewise, most (51.4%) HIV infections in women occurred through heterosexual transmission (Malaysia 2014 Global AIDS Response Country Progress Report), with most of these being concentrated around Sabah and Sarawak States. Whereas the infection among males has shown a significant decline since 2003, infection in females has shown an opposite trend. Progressively, more infections amongst women and girls are being reported and constituted 21% of new infections countrywide in 2011, relative to about 5% in 2001. In reference to the 2012 UNAIDS Global Report, "the incidence rate of HIV infection among adults 15-49 years old has decreased from 49% to 26% between 2001 and 2011" (Malaysia National Strategic Plan, 2011-2015).

Worldwide, there have been significant and sustained efforts in ensuring universal access to HIV prevention, care and treatment services through collaborative efforts between the respective national Governments and International donor organizations, particularly in low and middle income countries, in line with the Millennium Development Goals. However, the gap between the number of those requiring ART and those who have access to it still leaves much to be desired, with most developing countries still having 50% – 60% unmet needs. The Malaysian Government, as at end of 2013, currently almost entirely provides all the funds for HIV treatment care and support for about 17,369 patients at no cost to the patients on first line medications and heavily subsidized for those on second line ARVs (Malaysia 2014 Global AIDS Response Country Progress Report). The current number of patient on ART in Malaysia represents only about 47% of the estimated number of PLHIV eligible for ART (37, 274). Despite these efforts, the globally recognized issues of injecting drug use, stigma and discrimination as well as poor adherence to treatment (clinic visits and medication adherence) remain a stumbling block to the success of treatment programs and generate major concerns about resistance of the HIV virus to the currently available ARVs.

1.2 Problem Statement

The primary goals of HIV treatment are to reduce morbidity, prolong survival, improve quality of life, sustain viral suppression and preserve or improve immunologic functions. Medication adherence remains the cornerstone of long-term HIV suppression. Medication adherence prevents disease progression, and the occurrence of resistant mutations, thereby reducing morbidity, and the necessity for more frequent, complicated regimens which are also relatively more expensive. According to WHO (2005), minimum adherence levels of 95% are required for treatment success (Fairly et al., 2005; Jani, 2004; Paterson et al., 2000; Saple, 2005). Other studies have demonstrated that ARV medication adherence levels of 54 – 95% is required to maintain prolonged viral load suppression depending on the allowable flexibility margins of each ART program. "It is however generally accepted that those patients who adhere strictly to their medication achieve viral suppression, while those who are not adherent may not" (Lee Preininger et al., 2011).

Adherence is a concept with social and emotional components, therefore a therapeutic alliance between the provider and the patient is required to stimulate positive behavioural change and optimize adherence to ART. Several studies to improve adherence have focused on re-enforcing the patient's commitment and intention to adhere to their medications as a means to stimulate good adherence behaviour. These often include patient education and counselling, use of reminder devices including text messages, adherence case management, and directly observed therapy either as single interventions or in combination. Evidence from these studies have proven their relative effectiveness in improving adherence behaviour.

Several studies have identified stigma and discrimination, pill burden, disclosure issues, depression, medication side effects, drug and alcohol use, unemployment, health and religious beliefs, low family income, lack of community support and integration,

poor pre-initiation adherence counselling as some of the factors that contribute to poor medication adherence and the consequent rate of default and lost-to-follow-up.

Because of its strengths and evidence of wide applicability in the field of health behaviour research, the Theory of Planned Behaviour as described by Icek Azjen (1985) has gained international acceptability and recognition in its ability to enable researchers understand in details the determinants of current intentions and behaviour, predict future health intentions and behaviour and predict which health determinants should be targeted to change behaviour.

Recent innovations using mobile phone technologies such as text messaging to improve medication adherence among patients on ART have been examined and implemented across many countries of the world including Kenya, Peru, Brazil, Botswana, USA with high quality evidence proving the efficacy of weekly SMS reminders to patients in improving adherence to ART when compared to standard of care, particularly in three randomized controlled trials conducted in Kenya (Hovart T. et al., 2012; Lester R.T. et al., 2010; Pop-Eleches C. et al., 2011). Another study systematically reviewed the "scope and effectiveness of phone messaging for HIV/AIDS care" based on different study designs (RCTs, Intervention studies using other study designs, qualitative and cross-sectional surveys) across USA, UK, Kenya, Uganda, Botswana, South Africa, Peru, Pakistan among other countries and concluded that mobile phone messaging could play an important role in HIV/AIDS care and its use is acceptable (van Velthoven et al., 2013). However, further studies across low, middle and high income countries, scale-up of program evidence in hospitals, including cost-effectiveness analysis were recommended.

In Malaysia, like other parts of the world, poor or sub-optimal adherence to treatment (clinic visits and medication adherence) remains a stumbling block to the success of antiretroviral treatment programs and generates major concerns about possibility of growing resistance of the HIV virus to the currently available ARVs. Poor adherence is also a major cause of treatment failure, disease progression and death among HIV patients. Once treatment failure results from poor adherence, the preventive opportunity that antiretroviral treatment provides is lost. Poor adherence also has grave socioeconomic impact on program funding, as more patients who fail on first line regimens have to be provided with the more expensive and complex second line medications (Malaysia National Strategic Plan, 2011-2015; WHO, 2007). The effectiveness of routine adherence counselling (current standard of care) on treatment adherence among HIV patients on ART has not been studied in Malaysia. Factors affecting adherence to ART in HIV patients has also not been extensively studied in Malaysia. Previously, only one study on the factors affecting adherence to ART in HIV patients had been conducted in Malaysia (Yagoub et al., 2012). This is in addition to the seemingly high rate of IDUs, and other co-morbidities among HIV patients (Malaysia National Strategic Plan, 2011-2015). It has therefore become pertinent to identify innovative ways of improving clinic attendance, medication adherence and outcomes of HIV patients on ART.

1.3 Significance of the study

The findings of this study will contribute to the existing body of knowledge on factors associated with treatment default and lost-to-follow-up among ART patients. The results will also provide baseline information on the effectiveness of current standard of care (routine adherence counselling) on treatment adherence and clinical outcomes of HIV patients on ART, which has not been previously studied in Malaysia. As patient retention is the goal standard for measuring the success of any comprehensive HIV care and treatment program, this research will provide an opportunity to test the effectiveness of the introduction of mobile phone technology in improving patient retention (by reducing lost-to-follow-up) in the research location.

The outcome of this research will also inform policy decisions, new strategies and actions by Malaysian Government, care-givers and stakeholders at all levels in improving service delivery for HIV patients (especially with regards to treatment adherence and patient retention), reduce the cost of HIV treatment programs (by reducing the number of patients that will require second-line ARVs due to poor adherence) and also inform the scale-up of this intervention across Malaysia in the future.

This study is in line with key activity 6 of strategy 2 in the current drive by Malaysian Government to promote treatment adherence and enhance timely detection of treatment failure (Malaysia National Strategic Plan, 2011-2015). It is also consistent with current WHO recommendation of interventions to optimize adherence to ART (WHO, 2013).

1.4 Research Questions

1. What are the socio-demographic factors that affect treatment adherence and contribute to treatment default and Lost-to-follow-up among HIV patients on ART?
2. What is the impact of mobile phone reminder module (delivered via SMS and telephone call reminders) on clinic attendance and medication adherence among HIV patients on ART?
3. What is the effect of medication adherence on clinical (weight), immunological (CD4 count) and virological (viral load) outcomes of HIV patients on ART?

1.5 Objectives of the study

1.5.1 General objective

The general objective of this study was to determine the impact of mobile phone reminder module (delivered via SMS and phone call reminders) on adherence (clinic attendance and medication adherence) and treatment outcomes among human immunodeficiency virus positive patients on antiretroviral therapy in Malaysia.

1.5.2 Specific objectives

The specific objectives of the study were as follows:

1. To describe socio-demographic factors (such as age, ethnicity, gender, employment and education status, income) that affect treatment adherence and contribute to treatment default and lost-to-follow-up among HIV positive patients on ART.
2. To develop and implement a reminder module delivered through SMS and telephone calls to improve adherence (clinic attendance and medication adherence) among HIV positive patients on ART.
3. To determine the impact of mobile phone reminder module (delivered via SMS and telephone call reminders) on clinic attendance and medication adherence among HIV positive patients on ART.
4. To determine the effect of medication adherence on the clinical (weight), immunological (CD4 count) and virological outcome (viral load) of HIV positive patients on ART.

1.6 Research Hypotheses

H_1: There is no significant difference in the socio-demographic characteristics of HIV patients who adhere very well to their ART compared to those who do not.

H_2: The application of mobile phone reminder module (SMS and phone call reminders) will positively impact adherence and treatment outcomes of HIV patients on ART, when compared to routine adherence counselling and paper-based appointment scheduling alone.

H_3: There is a strong and direct relationship between good adherence to treatment (regular clinic visits and strict medication adherence) and clinical (weight), immunological (CD4 count) and virological (viral load) outcomes of antiretroviral treatment among HIV patients on ART.

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LIST OF PUBLICATIONS

Abdulrahman, S. A., Rampal, L., Othman, N., Ibrahim, F., Kadir@Shahar, H., Radhakrishnan, A. P. (2015). Baseline adherence, socio-demographic, clinical, immunological, virological and anthropometric characteristics of 242 HIV positive patients on ART in Malaysia. Malaysian Journal of Medicine and Health Sciences, 11 (2), June 2015: 45-58.

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