Effect of a weekly SMS reminder on Adherence and Quality of Life among HIV/AIDS patients on ART in Rural Botswana, Prospective Cohort Study

Lamboly G N. Kumboneki*
Public health, Texila American University, Botswana
Corresponding Author: glamboly@gmail.com

Abstract

Objective: Though the use of mobile in the African continent is continuously growing, there are limited evidence on its use and effect on patients on ART. This study assessed the impact of mobile phone technology on adherence and quality of life among HIV/AIDS patients on ART.

Methodology and Design: Between October 2016 and July 2017, we conducted a randomized controlled intervention at Lethlakane Primary Hospital in rural Botswana with 298 patients equally distributed in the intervention and control arm.

Over a period of 24 weeks, we sent weekly SMS to PLHIV on ART and responses were expected within 48h. Messages and scheduled measurements were provided in English and Setswana, according to the participant's preference.

Results: In intention-to-treat analysis, participants of the intervention arm received weekly SMS and maintained at least 90% of adherence to ART and similar achievement was also recorded in the control arm; However, SMS intervention was significantly associated to improvements in quality of life in the intervention arm (95% of patients) compared to the control arm with only 25% improving their QoL. (p 0.003).

Conclusion: Mobile technology offers a great opportunity to improve accessibility to services and a platform for interaction with patients. Further researches should be conducted to understand how best mobile technology could be used in a cost-effective manner and for better efficiency.

Keywords: Quality of life (QOL), Mobile Technology, Adherence to ART, People living with HIV.

Introduction

In 2018, an estimated 36.9 million people were living with HIV worldwide; 70% of whom reside in the Sub Saharan region of Africa house to 12% of the global population (1).

In Botswana, recent epidemic's estimate shows that 360 000 people are HIV positive about approximately 310 000 on ART and 96% being virally suppressed.

Since the launch of the ARV program in 2002, not only has the grave portrayal of the epidemic drastically improved but also thousands of HIV related deaths have been averted. A substantial decrease in mortality, from $12 \cdot 8$ deaths per 100 person years within 3 months of treatment initiation to $1 \cdot 16$ deaths per 100 person-years after a year of ART has also been noted(3). Worldwide; approximately 14.4 million life-years have been gained among adults between 1995 and 2009 as a result of ART intervention (2).

Beyond the bio-immunological impact of this life saving intervention, ART also improves quality of life of patients adhering correctly to the treatment(4).

WHO defines Quality of Life as individuals perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns(5). Health related quality of life is an important indicator to assess the impact and the quality of health care system(2); better it portrays a patient assessment of the impact of an health care intervention in various aspect of his life such as spiritual, social and environmental.

Affecting positively patients' quality of life has been one of the achievement of ART(6) and eventually a key to not only reinforced adherence among HIV/AIDS patient but also retention to care. According to the Botswana ARV national program, approximately 3% of patients will drop out of care at any given time.

This, given the paucity of options or drugs available to treat drug resistance strain combined with the financial burden on an already stretched (overwhelmed) Health system constitutes a great concern and should be timely addressed. Thus, it is important to explore new approaches to continuously support and retain HIV/AIDS patients to care.

Hence, effective interventions to enhance quality of life are needed. The increasing usage of new mobile technologies worldwide especially the wireless communications provide an opportunity in the short message service to enhance efforts to improve quality of life among HIV/AIDS patients(7).

The objective of this paper was to assess the impact of mobile phone technology on adherence and quality of life among HIV/AIDS patients on ART.

Methodology

Study setting

The study took place at Letlhakane Primary Hospital,a health care facility providing primary care services in rural Botswana.

Letlhakane is located in the central region of Botswana at the heart of mining activities approximately 220 km from Francistown, the second town, in the North East. Its population is estimated at 22941

The 30 beds Hospital serves as a referral centre to 7 clinics and health post within a catchment area of 100km and its infectious diseases centre provide ARV services to approximately 3000 patients.

Study population

All HIV infected patients on ART at Letlhakane Primary Hospital IDCC.

Inclusion Criteria:
- Owning a cell phone
- Not imminently transferring to other hospitals or relocating to another town.
- Patients on ART for at least a month.
- Illiterate patients will be eligible if a literate partner assists them.
- Exclusion Criteria:
- Patients recently initiated on ART (< 1 month).
- Illiterate patients without assistance or support

Sampling and procedure

Using the OpenEpi application, the required sample size was estimated to be at least 145 patients per arm to detect an improvement of 8% in adherence rate from 90% (4) to 98% with 80% power and 0.05% level of significance.

On routine ARV clinic's day, using a convenience sampling method, patients were approached and proposed to participate into to the study and after obtaining a verbal agreement; an informed consent form was given for written approval. Once the consent obtained, an envelope containing the study identification number was randomly picked. All patients that received an odd number were allocated to the exposed group while those having even numbers were assigned to the control group.

This procedure continued in the subsequent days until the required sample was obtained.

Quality of life was assessed in all participants using the WHOQOL-HIV BREF at week 0 and 24.

The WHOQOL-HIV BREF is a shorter version of the WHOQOL –HIV, which is a tool developed by the WHO to assess the quality of life among HIV positive patients.

Study design

This prospective cohort study was conducted at the Letlhakane Primary Hospital.

The study design was chosen because of the comparative nature of the study. Therefore, this study comprised two groups: the first group was the exposure group while the second was the control.

Measures and tool

Bio-socio demographics information was collected by a research assistant and directly entered into the database. CD4, viral load, age, gender, education level, marital status was collected at enrolment and adherence to ART was monthly assessed during the study.

The WHOQOL-HIV BREF is based on the WHOQOL-BREF, the shorter form of the WHOQOL-100. This contains five extra items specific to PLWHA, and in total contains 31 items. The WHOQOL HIV BREF contains 6 domains (physical, psychological, level of independence, social relationships, environment and spirituality) and 29 facets with 5 which are specific to HIV/AIDS (Forgiveness and Blame, concern about the future, Death and Dying, Symptoms of PLWHA and social inclusion).

The six domain scores denote an individual's perception of quality of life in the following domains: Physical, Psychological, Level of Independence, Social Relationships, Environment, and Spirituality.

The physical domain includes three facets: pain and discomfort, energy and fatigue, and sleep and rest. The psychological domain includes five facets: positive feelings, negative feelings, learning and concentration, bodily image, and self-esteem.

The social domain includes three facets: personal relationships, practical social support, and sexual activity. The environmental domain includes five facets: financial resources, healthcare availability, opportunities for acquiring new information and skills, opportunities for leisure, and transport. Each facet consists of two to eight items.

Individual items are rated on a 5-point Likert scale where 1 indicate low, negative perceptions and 5 indicates high, positive perceptions. For example, an item in the positive feeling facet asks "How much do you enjoy life?" and the available responses are 1 (not at all), 2 (a little) 3 (a moderate amount), 4 (very much) and 5 (an extreme amount). As such, domain and facet scores are scaled in a positive direction where higher scores denote higher quality of life. Some facets (Pain and Discomfort, Negative Feelings, Dependence on Medication, Death and Dying) are not scaled in a positive direction, meaning that for these facets higher scores do not denote higher quality of life. These needed to be recoded so that high scores reflect better QoL.

Scoring Procedure

First, all scores needed to be checked that they were in the appropriate range (between 1 and 5).

Domain scores were scaled in a positive direction where higher scores denote higher quality of life. Some items were not scaled in a positive direction (e.g. Pain and discomfort, negative feelings, dependence on medication, death and dying), meaning that for these facets higher scores do not denote higher quality of life. These needed to be recoded so that high scores reflect better QoL. Domain scores are scaled in a positive direction (i.e. higher scores denote higher quality of life). Therefore, the following questions were reversed so higher score could reflect a better QoL, Q3 Q4 Q5 Q8 Q9 Q10 Q31 were if the patient ticked 1 then question was

given a 5 as score, 2 was reversed to 4,3 remained the same,4 was reversed to 2 and 1 was reversed to 5 (1=5) (2=4) (3=3) (4=2) (5=1). The mean score of items within each domain is used to calculate the domain score and raw scores obtained are transformed to make domain scores comparable with the scores used in the WHOQOL-100.

The score for each domain ranges from 4 being the lowest to 20, the maximum.

Statistical analysis

Stata v13 was used to analyze data. Mean, standard deviation and percentage were used to describe data. K-S and Mat Whitney test were used to compare data within groups of the same variable.

Bivariate and multivariate regression analysis (using a nested model) were done to establish the association between the mobile phone intervention and QOL scores of exposed and non-exposed patients. Same analysis was run as well to establish relationship between QoL and socio-demographic factors and QoL as well between socio demographics factors and the SMS intervention.

All hypothesis testing was based on 2-sided tests with an alpha level of 0.05. The continuous variables were entered into the multivariate regression directly, for instance age and CD4 count. However, the ordinal or categorical variables were grouped and coded, for example educational status (1 = none, 2 = Primary, 3 = Secondary, 4 = Tertiary and above), Marital status (1 = Single, 2 = Divorced or widowed, 3 = Married) and gender (1 = male, 2 =female).

Ethical consideration

The Human Research and development committee at the Ministry of Health as well as the District Health Management Team at Letlhakane approved this study.

Inform consent was obtained from each patient and participants were informed that they could withdraw from the study anytime and this would not affect the quality of service they received from the facility. All information gathered in this study would be treated as confidential; the research team could only access all information about participants.

Identifiers such as name, gender and other personal information were collected in a different form and stored separately.

Results

Bio socio-demographic factors
Total sample

Between October 1 2016 and 30 July 2017, a total of 298 participants were enrolled and followed for 24 weeks, 3576 SMS were sent and 276 calls were made during that period with a response rate of 85%.

Among participants, 162 were females (54.4%) and males were 136 (45.6%); participants age ranged between 10 and 79 years with the age group of 35 to 44 accounting for 39.6% followed by those between 25 and 34 who constituted 26.2% of the sample. 54% (161) were single ,15.1% (45) were married at the time of data collection while 137 had a couple's life experience. The majority or 87.4% of participant received a primary education or above while 12.6% (38) did not receive any formal education.

Most patients or 268 (89.3%) had a CD4 count above 250 and 290(97%) had an undetectable viral load

(VL<400).

Exposed group

Consistent with the reality depicted in the total sample, majority or 64 (42.9%) participants were aged between 35 and 44 followed by those aged between 25 and 34 ,44(14.8%);22 had an age between 45 and 54 while 13 were older than 55 and 6 youngers than 25.

78 participants were single while 25 were married and 39 living as married. In this group, 1 was separated; 2 divorced and 4 were widows.

The vast majority had completed a secondary education, 88 (), only 12 did not receive any formal education, 17 had a tertiary qualification while 32 completed their primary school.

128 had a CD4 count superior to 500 while 145 had an undetectable viral load

This group had 68 males and 81 females.

Control group

As reflected in the all sample, several or 54(36.2%) of participants were aged between 35 and 44 followed by those aged between 25 and 34, 34(22.8); 27(18.1%) were in the age category of 45 to 54 while 26(17.4) were older than 55 and 6(4) youngers than 25.

More than the half or 83 participants were single while 20 were married and 31 living as married.16(10.7%) patients were widows,5(3.3%) separated from their partner and 1(0.7%) divorced.

The vast majority had completed a secondary education,75 (50.3%), 26(17.4%) did not receive any formal education and 13(8.7%) had a tertiary qualification.35(23.5%) participants completed their primary education.

140 had a CD4 count superior to 500 while 145 had an undetectable viral load

This group counted 68 males and 81 females or 149 patients.

Table 1. Bio-socio demographic characteristics of participants.

Variables	All	SMS	No SMS	P Value
Age				
<25	14(1.57%)	6	8	0.111
25-34	78(26.17%	44	34	
35-44	118(39.59%)	64	54	
45-54	49(16.44)	22	27	
>55	39(13.08)	13	26	
Sex				
Male	136(54.4%)	68	68	1.0000
Female	162(45.4%)	81	81	
Marital Status				
Single	161	78	83	0.234
Married	45	25	20	
Living as married	70	39	31	
Separated	1	1	0	
Divorced	05	2	3	
Widowed	16	4	12	
Education level				

None	38	12	26	0.076
Primary	67	32	35	
Secondary	163	88	75	
Tertiary	30	17	13	
CD4 at time 0				
0-250	32	22	10	0.068
250-500	141	65	76	
>500	127	63	64	
Percentiles				
VL at time 0				
VL suppressed	290	145	145	1.00000
VL not suppressed	10	5	5	

Inferential analysis

Adherence to ART, Quality of life and Patient Health care provider relationship were assessed at the beginning and the end of the study for both groups and differential was calculated to depict any improvement in participants' respective scores.

Thereafter logistic regression was applied to analyze the impact of our intervention on Adherence to ART and Quality of life.

However, this study noted a good quality of life among patients on ART and these findings are consistent with several other studies who noted such improvement as well in PLWHA on ART[6][8]

Adherence to ART

During the intervention, adherence has been measured 1050 times for each group and each patient was assessed 7 times during the study. Adherence was measured by the pill count method at each visit.

In both group adherence was high at the beginning and at the end of the study. The exposed group had a mean adherence at 98.7 at the beginning of the study and 99.8 at the end while the control group had a mean adherence estimated at 95.5 at the end of the study and 98.6 at the beginning.

Though there has been an improvement in ART adherence in the exposed group, the difference between both groups at the beginning and at the end of the interventions were not statistically significant.

Quality of life and SMS intervention

Exposed group

At enrolment in the exposed group, PLWHA on ART at Letlhakane Primary Hospital had an overall mean QOL of 16.26 ± 2.44.

Assessing each and every domain separately, we obtained the following means: 16.76 ± 3.44 for the physical domain, 16.43 ± 3.08 for the psychological domain; 15.92 ± 3.30 for the level of independence; 16.96 ± 3.18 for the social relationship; 14.79 ± 2.71 for the environmental domain and 16.72 ± 3.57 for the spiritual domain

At the end of the study; the overall mean of QOL was 16.96 ± 2.40

Regarding different domains, we had the following findings; 16.78 ± 3.43 for the physical domain, 16.44 ± 3.19 for the psychological domain, 17.49 ± 3.25 for the level of independence, 17.84 ± 3.20 for the social relationship domain, 15.27 ± 2.74 for the environmental domain and 16.72 ± 3.8 for the spiritual domain.

Control group

Initially, for PLWHA enrolled in the control arm, the mean of the overall quality of life was 16.70 ± 2.31.

Concerning singular components of the quality of life, we had the following findings; 16.54 ± 3.27 for the physical domain, 16.62 ± 2.91 for the psychological domain, 15.73 ± 3.19 for the level of independence; 16.41 ± 3.10 for the social relationship domain, 14.79 ± 2.66 for the environmental domain and 16.96 ± 3.58 for the spiritual domain.

At the end of the study, the mean for the overall quality of life was at 16.26 ± 2.04.

Introspecting into each domain, we obtained the following results: 16.83 ±3.22 for the physical domain, 16.88 ± 3.08 for the psychological domain, 16 ± 3.37 for the level of independence, 16.08 ± 3.18 for the social relationship domain, 14.99± 2.87 for the environmental domain and 16.92 ±3.75 for the spiritual domain.

Comparing both groups

At the end of the study, in a bivariate analysis, after accounting for all confounders; SMS intervention(p 0.003) and education level(p 0.011) were significantly associated with an improvement in quality of life in the exposed arm while other variables such as gender, age and marital status were not associated with such improvement. The controlled arm did not show any significant improvement

The same result was obtained in a multivariate analysis for the SMS intervention (p=0.000) while there was no significant association between education level of a patient and quality of life (p=0.962).

By disaggregating the quality of life and equating the differential of each of its component, a bivariate analysis further revealed that changes in quality of life were mainly driven by the following components: level of independence (p=0.031), environmental (p=0.025) and social relationship(p=0.017).

Physical (p = 0.305), spiritual (p= 0.864) and psychologic (p 0.385) components were not associated with an improvement in quality of life.

However, a multivariate analysis including each component of quality of life at different time; all the six components had a significant association with the patient health care relationship (p= 0.000).

Table 2. QOL's comparison between the control and the exposed group

	Pre-Intervention		Post Intervention	
Domain	Control group	Exposed group	Control group	Exposed group
Physical	16.54	16.76	16.83	16.78
Psychological	16.62	16.43	16.88	16.44
Level of independence	15.73	15.92	16	16.49
Social relationship	16.41	16.96	16.08	17.84
Environmental	14.79	14.79	14.99	15.27
Spiritual	16.96	16.65	16.92	16.72
Overall QOL	16.70	16.36	16.26	16.96

Table 3. Bivariate analysis Quality of Life

Variables	Coefficient	CI (95%)	P value
SMS	2.497088	.8457952 4.148381	0.003
GENDER	-1.030704	-2.709889 .64848	0.228
Education level	.7028369	.1598489 1.245825	0.011
CD4 differences	.000455	-.0043529 .005263	0.852
VL diff	.0000312	-.0002964 .0003589	0.851
Education level			
None	2.592364	.3992977 4.78543	0.021
Primary	2.054644	.0528696 4.056418	0.044
Secondary	3.37094	1.296691 5.445189	0.002
Tertiary	2.772363	-.5172358 6.061963	0.098
Age			
≤25			

25-34	2.929092	-.0426331 5.900817	0.053
35-44	2.738258	-.1613212 5.637838	0.064
45-54	2.819509	-.257264 5.896281	0.072
>55	2.406461	-.7448867 5.557808	0.134
Marital Status			
Single	.3636944	-8.949379 9.676768	0.939
Married	.5904757	-8.802948 9.983899	0.902
Living as married	.5577465	-8.790957 9.90645	0.907
Separated	2	-8.719726 12.71973	0.714
Divorcee	1.157143	-8.767395 11.08168	0.819
Widow	-.5090922	-10.20545 9.187265	0.918

Quality of life and age

Considering the age, patients aged less than 25 years had a mean QoL score at enrolment at 15.5 ± 1.77, those who were aged from 25 to 34 had QoL mean score at 16.1 ± 2.28, in the age category from 34 to 43 the mean QoL score was at 16.62 ± 2.71, in the age category of 44 to 54; the mean QoL score was at 16.86 ± 2.05 and the last category of those of ≥55; the mean QoL score was at 16.94 ± 1.86.

At the end of the interventions QOL mean scores were as follows per age category ,15.16 ± 2.10 for patients younger than 25 years,15.87 ± 2..31 for patients aged from 25 to 34, 99.07 ± 13.95 for patients aged from 35 to 44,16.51 ± 1.93 for patients aged from 45 to 54 and 16.64 ± 1.93 for patients older than 55 years old

Comparing QoL, patients ≥ 35 had a better quality of life than those younger and the difference was statistically significant at the beginning (p=0.001) and at the end of our intervention (p= 0.003).

Comparing all the 5 age categories at the same time, QoL were statistically different at enrolment (p=0.0287) and the end of the study (p=0.0488)

Quality of life and Education

At enrolment; regarding the education level of study's participants; patients without any formal education had an overall mean QoL at 16.14 ± 2.96, those who received a primary education had a mean QoL at 16.64 ± 2.12 while those with a secondary education 16.61 ± 2.48 and participants with a tertiary qualification had a mean QoL at 16.82 ± 1.67.

At the end of the study; overall mean QoL for participant without formal education was at 16.25 ± 2.26, those with a primary education had a mean QoL at 16.32 ± 2.16, participants with secondary education had a mean at 16.51 ±2.42 while those with a tertiary qualification at 16.6 ± 1.51.

However, using the Kolmogorov-Smirnov test; at the beginning of the study the difference was statistically significant between participant without formal education and those with any form of education (p=0.447) and we had the same observations at the end of the intervention (p=0.462).

By running a Kruskal Wallis, there was no significant difference between different groups at the initial assessment (p=0.6912) and at the end (p=0.2173)

Discussion

Adherence to ART

Unlike previous study conducted in the continent (14), our study did not show any significant relationship between the SMS intervention and improvement in adherence. Similar findings were also noted by Mbuagbaw et

al. (15) who did not find any significant improvement in adherence among patients who received SMS intervention .In the specific context of our intervention, both groups demonstrated good adherence before and through the intervention and though there was a slight improvement in adherence among patients in the intervention group, the difference was not significant to be attributed to the weekly SMS. However, it is also important to note that patients with low adherence at the beginning of the study contributed the most to an improvement of the overall mean adherence in the intervention arm hence it is important to prioritize a targeted approach while envisaging such intervention.

Quality of life and SMS intervention

To our knowledge, few studies have assessed quality of life among people living with HIV in Africa and the impact of mobile technology intervention on it. In this study we assessed patient's quality of life at the beginning and the end, and in both situation; patients on ART had a high score of quality of life with the physical domain being the highest and social relationship scoring the lowest mark in both groups. These findings are consistent with results from study in China and India(7,8) where the environmental domain had the second lowest score.

Moreover, like in previous study(7), the weekly SMS intervention has shown a significant correlation with quality of life ,as there was an improvement in quality of life among patients enrolled in the exposed group as opposed to the control group.

There was no significant improvement in quality of life among the controls.

The main changes or improvements noted in quality of life were driven by 3 particular domains, which were level of independence, social relationship and environment. In a bivariate analysis, these three domains of quality of life had an association statistically significant with our SMS intervention.

The changes in these particular 3 domains could be explained by different facts pertaining from the type of items or questions each and every domain is composed of.

Looking at the social relationship domain; improvements were mainly noted in the items concerning social support and acceptance by other people (social relationship has 4 items). Concerning the environmental domain composed of 8 items, changes were mainly driven by 2 items as well; those regarding availability of information and accessibility to health service as patient could ask questions and be timely answered as well as the availability of a Health Care Provider to respond to their questions and queries.

For the level of independence, the main change was noted on the item concerning the possibility of getting around which may also be explained by the easy accessibility to health services and health care worker through a SMS or a phone call.

Quality of life and socio-demographics factors

In our study; at enrolment; males had a better quality of life than female though these differences in QoL were not statistically significant(10).However; a t the end of the study, difference between males and females participant was statistically significant and similar to other studies with males still having a better score than female(9,7) .

From the beginning, some significant differences in quality of life were noted with patients younger than 35 having a lower quality of life than those older. The same observation was done at the end of the study where participants of 35 years of age and older still had a better quality of life than the younger. These findings are contrary to those noted in previous study where younger people had a better quality of life than elderly(8,7).The reason may be the negative effect of unemployment on youth health(12) as Botswana has a high unemployment rate in this age category constituting the main labor force(12). This particular observation in our study may be due to the study setting which took place in a rural area with high unemployment rate among youth.

Concerning the level of education ,in our study there were no difference statistically significant between patients without any formal education and any other category and as well between different categories unlike findings from Liping and al which showed a better QoL among patients with higher education level(9).

Widowed, separated and divorcee individuals are usually reporting a poor quality of life as compared to married and it is the same situation when you compare the 3 groups named above to singles never married(13) however in our study singles and widowed patients had the lowest QoL as compared to the other groups.

Conclusion

In Rural Botswana, patients on Anti-retroviral therapy portray a good adherence and quality of life, however it is crucial to provide a continuous support and services in order to maintain and improve the benefit of this lifesaving treatment. Mobile technology offers a great opportunity not only to improve accessibility to services but also offers a platform for patients' queries and questions as demonstrated in our study. Further researches should be conducted to understand how best mobile technology could be used in a cost-effective manner and for better efficiency.

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