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# Electronic Medical Records and Same Day Patient Tracing Improves Clinic Efficiency and Adherence to Appointments in a Community Based HIV/AIDS Care Program, in Uganda

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## Abstract

Patients who miss clinic appointments make unscheduled visits which compromise the ability to plan for and deliver quality care. We implemented Electronic Medical Records (EMR) and same day patient tracing to minimize missed appointments in a community-based HIV clinic in Kampala. Missed, early, on-schedule appointments and waiting times were evaluated before (pre-EMR) and 6 months after implementation of EMR and patient tracing (post-EMR). Reasons for missed appointments were documented pre and post-EMR. The mean daily number of missed appointments significantly reduced from 21 pre-EMR to 8 post-EMR. The main reason for missed appointments was forgetting (37%) but reduced significantly by 30% post-EMR. Loss to follow-up (LTFU) also significantly decreased from 10.9 to 4.8% The total median waiting time to see providers significantly decreased from 291 to 94 min. Our findings suggest that EMR and same day patient tracing can significantly reduce missed appointments, and LTFU and improve clinic efficiency.



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### Keywords

Clinic efficiency; Electronic medical records (EMR); Patient tracing; Clinic appointments; Patient waiting time

## Introduction

The campaign to improve access to antiretroviral treatment (ART) has shifted from initiating many patients on treatment as fast as possible to how scaled-up programs can be made efficient and sustainable. This paradigm shift is very timely considering the declining success in adherence and retention that "younger" ART programs have reported [1–3]. High patient load with reduced clinic efficiency lead to long waiting times and reduced patient satisfaction, which may consequently reduce patient retention. Likewise, missed clinic appointments could affect patient load and the ability to plan since the number of daily visits cannot be predicted. In addition, patients who miss appointments may show up very ill and require more frequent and longer consultations. Moreover, missed appointment rates are the most significant predictor of treatment failure [4, 5] and loss to follow up [4].

Electronic medical records (EMR) that involve logging in scheduled clinic visits allows for prompt identification of patients who miss appointments thereby facilitating timely tracing. However, they have not been prioritized in ART scale-up in resource limited settings.

Between April and June 2008 we conducted a time and motion study at Reach Out Mbuya Parish HIV/AIDS Initiative (ROM) and identified bottlenecks in clinic efficiency including long patient waiting times at the point of a manual records retrieval [6]. We implemented and evaluated the impact of EMR coupled with same day patient tracing as a strategy to reduce missed clinic appointments and improve clinic efficiency.

## Methods

### Study Setting

The study was conducted at Reach Out Mbuya (ROM) located in Kampala (the capital city of Uganda). Reach Out Mbuya HIV/AIDS Initiative is a community-based, Non-Governmental organization that provides free comprehensive HIV care, treatment and support services to approximately 3400 patients, 2100 of whom are on ART. ROM operates within a defined catchment area of about 95,000 mobile inhabitants of low-socio-economic status and has three satellite clinics (Mbuya, Banda and Kinawataka). This evaluation was conducted at the Mbuya clinic which serves approximately 40% of the patient population.

### Study Design

A before and after design was used to evaluate the effects of EMR and daily patient tracing on reducing missed appointments and improving clinic efficiency. The baseline (pre-EMR) assessment was conducted between April and June 2008. EMR was implemented in October 2008 and the post implementation evaluation (post-EMR) was conducted between April and June 2009, 6 months following the implementation of the EMR and patient tracing.

Data on early, missed and on-schedule clinic appointments and reasons for missed appointments pre-EMR were extracted from patient registers. Similar data for the post-EMR period were available electronically. A random sample of patients who missed appointments pre-EMR and post-EMR was analysed to ascertain reasons for missed appointments. In addition, time and motion data were collected to evaluate waiting times to see providers and time spent with various providers (clinic efficiency).

The Institutional Review Board of the Makerere University, School of Public health and the Uganda National Council for Science and Technology approved the study.

## Model of Care at Reach Out Mbuya HIV/AIDs Initiative

Reach Out Mbuya HIV/AIDS Initiative's (ROM) clinics are predominantly staffed by nurses with a nurse to doctor ratio of 7:1. Doctors provide oversight and consultation on complex cases referred by the nurses who do the routine patient care, ART initiation and follow-up. To ensure quality under this staffing model, continuous medical education is strongly emphasized.

For every newly enrolled patient, a comprehensive medical examination is conducted at the initial clinic visit, followed by a visit 2 weeks later when CD4 results are reviewed to decide on eligibility for ART. Other eligibility criteria for ART initiation include adherence to clinic appointments and Cotrimoxazole prophylaxis and HIV status disclosure to a spouse or family member. Patients prescribed ART undergo three to four counselling sessions to prepare them to adhere to the medication. In addition, they sign a "treatment agreement" to confirm their commitment to long-term therapy and consent to routine home visits by an assigned Community Health Worker. (CHW) The Community health workers are persons living with HIV (PLWHA) who closely monitor patients at home and remind them about clinic appointments. Patients with poor medication adherence and those who miss clinic appointments are referred for ongoing counselling. Patients who are newly started on ART are initially seen biweekly with a focus on medication adherence and screening for adverse effects. Thereafter, stable patients are reviewed monthly.

**Implementing Electronic Medical Records (EMR) and Same Day Patient Tracing—**Patients receive appointment cards, which they present on arrival at every clinic visit to register their attendance. For every patient attending the clinic, providers verify the date of the clinic visit against the dates on their appointment cards to determine whether the visit is on-schedule, early or the patient missed an appointment. Reasons for early or missed appointments are recorded in the patient clinical records forms.

Prior to October 2008 when the EMR and patient tracing system were implemented, we maintained a manually updated patient register. Missed appointments could only be ascertained after 1 month, or not at all if the patient was lost to follow up. In many instances, patients forgot to bring their appointment cards, and the registry staff had to manually search for the patients registration number from the patient register, leading to delays in file retrieval.

In October 2008, we implemented an EMR system to replace the manual system. At the end of each patient encounter, real-time appointment status and next appointment visit dates are entered into an EMR by data clerks. The EMR is used to generate a list of scheduled appointments for each clinic day and a patient list is printed and used for file retrieval a day prior to the clinic day. Patients are classified as on-schedule or early at registration and as missed appointment at the end of the clinic day. The list of patients who have missed appointments is generated from the EMR and given to the CHWs who initiate same-day patient tracing through a home visit. If the patient is found at home he/she is reminded to come to the clinic immediately. If the patient is not found at home the family members or neighbours are asked to provide information on the whereabouts of the patient. Patients who miss appointments become a priority for ongoing adherence counseling and routine reminders about subsequent clinic appointments. Furthermore, patients who miss scheduled appointments and visit the clinic on a later day without a valid reason are reviewed last as a penalty irrespective of their arrival time; a policy suggested by the patients themselves as a strategy to minimise missed appointments.

### Data Collection

**Patient Appointments—**For the 72 clinic days between April and September 2008 (pre-EMR) data were extracted from patient registration records and appointment cards to estimate the number of on-schedule, early, and missed appointments. Likewise, for the 72 clinic days between April and September 2009 (post-EMR) data were retrieved from the EMR to determine patient appointment status as indicated above. In addition, a random sample of 888 patients (660 pre-EMR, 228 post-EMR) who missed appointments were randomly sampled proportionate to the number of missed appointments during each time period to determine reasons for missed appointments.

**Waiting Times—**Time and motion data were collected between April and June 2008 and between April and June 2009, 6 months after implementation of EMR. The detailed methodology has been described previously [6]. In summary, each day the registry staff used the patient registration list to randomly sample patients from each of the following patient categories: new patients, patients undergoing preparation for ART, early ART patients (within the first 6 months of initiation), stable ART patients (6 months or more on ART) and stable non-ART patients; the five patient categories represented approximately one-fifth of the selected sample at both time periods. Purposeful sampling was done for categories with fewer patients in order to ensure balanced representation.

A data extraction tool containing: patients reporting time, waiting time before being seen by providers and time spent with various providers were recorded. The waiting time before being seen by the providers was captured by trained research assistants, while the time spent with the provider was captured by the providers themselves and checked by research assistants for accuracy and completeness. In order to ensure anonymity and objectivity in recording of time, providers did not include their names or other identifiers on the data collection tools. Also, the research assistants who gathered the tools were not part of Reach Out's established staff. Time and motion findings were used to evaluate changes in clinic efficiency following the implementation of EMR and same day patient tracing.

### Statistical Analysis

Analysis was conducted using Stata, version 11.0 (Stata Corp; Texas) and findings are reported at a significance level of $\leq 0.05$ (two-sided).

Descriptive analysis was used to depict patient appointments demographic characteristics of patients who missed appointments, reasons for missed appointments, and waiting times. Appointments were classified as "early" if a patient reported earlier than their scheduled appointment, "On-schedule" if they reported on the scheduled date and "missed" if they did not show up by the end of the scheduled appointment date. The mean number of missed, early and on-schedule visits was determined and the means between the two study periods compared using the Student's *t* test. Median waiting times during the post-EMR period were compared to pre-EMR estimates using the wilcoxon signed-rank test (one sample median test). Both *Z* and *P* values are reported.

## Results

### Clinic Attendance and Reasons for Missed Appointments

Overall, 3400 patients received care and treatment at ROM during the post-EMR period, compared to 3100 in the pre-EMR period. The number of clinic staff reduced from 19 to 13 post-EMR (less by: 2 nurses, 2 pharmacy assistants, 1 adherence counselor and 1 registry clerk). Of 7104 appointments that were scheduled during the entire study period, 2266 (32%) were missed, of which 1680 (74%) occurred pre-EMR and 596 (26%) post-EMR

(data not shown). In Table 1 we show the clinic attendance pre and post-EMR. The mean number of total daily clinic attendance was similar during the two periods: 68 pre-EMR versus 70 post-EMR ($t_{601} = 1.19$, $P < 0.001$). However, the mean number of missed appointments decreased from 21 pre-EMR to 8 post-EMR ($t_{601} = 15.31$, $P < 0.001$). There was also a significant reduction in mean daily early appointments from 11 pre-EMR to 9 post-EMR ($t_{601} = 3.85$, $P < 0.001$) and an increase in mean daily on-schedule appointments from 57 pre-EMR to 61 post-EMR ($t_{601} = -2.73$, $P = 0.007$).

Patient characteristics of the randomly sampled 888 missed appointments (660 pre-EMR, 228 post-EMR) were similar between the two time periods with patients who were female or married or not on ART being more likely to miss appointments (Table 2).

The main reason for missed appointments was forgetting (37%). However, there was a 30% reduction in missed appointments attributed to forgetting post-EMR ($P = 0.001$). Similarly, there was a 24% reduction in wrongly captured appointments post-EMR ($P = 0.001$). Only 11 (4.8%) missed appointments were a result of loss to follow-up post-EMR compared to 72 (10.9%) pre-EMR ($P = 0.001$). Missed appointments attributed to death was 3.0% post-EMR compared to 3.8% pre-EMR ($P = 0.6$). However, missed appointments because of severe illness or hospitalization increased 15-fold post-EMR (0.6–15.7%; $P = 0.001$) (Table 3).

### Patient Waiting Times

**Arrival Time—**The clinic opened at 8 a.m. during both study periods and registration of patients stopped at 12 p.m. with only emergency cases being registered after that time. Majority (60%) of the patients arrived between 7 and 9 a.m. (58% pre-EMR, 62% post-EMR) with 11% arriving before 7 a.m. and only 3% arriving after 12 p.m.

**Waiting Times—**In Table 4 we show the waiting times. The total time spent at the clinic during the post-EMR period decreased with significant reductions occurring in waiting time to see the nurses (38 min post-EMR vs. 56 min pre-EMR; $Z = -5.13$, $P < 0.001$), and the time to see the pharmacy technician (11 min post-EMR vs. 45 min pre-EMR; $Z = -7.25$, $P < 0.001$). However, there was an increase in time waiting to see the laboratory technician (42 min post-EMR vs. 15 min pre-EMR; $Z = 4.35$, $P < 0.001$). The total time spent at the clinic was longest for early ART patients (223 min; IQR, 161–180) followed by patients undergoing preparation for ART (195 min; IQR, 160–273).

Similarly, time spent with some providers decreased post-EMR and included time spent with the registry staff, pill counters and nurses with the most dramatic decrease occurring with the time spent with the pill counters which decreased form 14 min pre-EMR to 2 min post-EMR ($Z = -10.63$, $P < 0.001$).However, there was an increase in the time spent with some providers and included: laboratory staff (8.5 min pre-EMR vs. 23 min post-EMR; $Z = 3.94$, $P < 0.001$), pharmacy staff (16 min pre-EMR vs. 21 min post-EMR $Z = 5.78$, $P < 0.001$) and counselors (35 min pre-EMR vs. 43 min post-EMR; $Z = 1.56$, $P < 0.001$). Early ART patients spent the longest time with the providers (137 min; IQR, 75–199).

## Discussion

Our study shows that improvement in records management through computerization coupled with prompt patient tracing reduces missed appointments and improves clinic efficiency.

Effective management of HIV as a chronic disease necessitates the provision of a continuity of care which can only be achieved if patients are retained in care. However, limited infrastructure, lack of human resources, manual patient records, and limited ability to trace

patient's results in a healthcare system that is poorly equipped to provide good continuity of care. Coleman et al. [7] found that patients lost to follow up were twice more likely to have previously missed appointments compared to retained patients. Our intervention facilitated early identification and counseling of patients who miss appointments and allowed for timely adherence interventions thereby reducing loss to follow up. Studies in Kenya, Malawi and Uganda reported the use of EMR in tracing losses to follow up but success was hampered by the lack of valid physical address and wrong patient phone contacts [8, 9]. We used a patient tracing system that utilizes CHWs who are patients themselves and are resident within the same communities as their patients making physical tracing more feasible. In the study in Zambia [10], patients on ART were traced if they were at least 10 days late for a scheduled appointment. However, same day patient tracing as was done in our study, will identify those at risk to become lost to follow up earlier.

The total number of patients served increased during the post-EMR period but the daily clinic attendance did not differ. This could be explained by the significant reduction in the number of missed appointments which facilitated rational duty allocation and allowed more patients to be served. The reduction in the number of mean daily early appointments and mean daily on-schedule appointments although statistically significant may not seem significant from a clinical perspective. From our experience the majority of patients who come earlier than their appointment date have an acute illness and although the change in on-schedule appointments may seem minimal, the cumulative benefits of the intervention in reducing loss to follow up and improvements in medication adherence have a longer term benefit.

Forgetting was a major reason for missed appointments which is consistent with reports of other published studies [8, 11] highlighting the need for innovative patient focused reminder strategies. The World Health Organization in 2005 proposed the use of low-cost information and communication technology (Mobile electronic Health) to improve the quality of service delivery, including continuity in care in resource limited settings [12, 13]. Although the strategy has proved to be successful in some settings, success is hampered by limited access to mobile phones and by wrong phone contacts. In our study there was a significant reduction of missed appointments due to forgetting during the post-EMR period, highlighting the role CHWs play in reminding patients to adhere to appointments. However, same day patient tracing may not be efficient and sustainable as the number of patients increase. Moreover, some patients may after all return without any intervention after a few days, rendering the strategy not cost-effective. There is a need to evaluate the optimum time and other markers for intervention after a missed appointment. More importantly, a dual strategy using mobile phone communication and CHW patient tracing may be more cost effective and needs to be evaluated. Other reasons cited for missed appointments were: being too busy with other commitments including work and school, having enough medication and being ill. Many patients can only take a few hours out of work for health care due to various barriers including HIV status non-disclosure, and non flexible working hours. This highlights the need for HIV programs that take into consideration the improved quality of life of PLWHA including the need for longer intervals between appointments. Costs for transport to and from health services can be a significant barrier to care [14, 15], but this was not a barrier to clinic appointments in our study, probably because ROM provides services through geographically accessible clinics. A significant proportion of missed appointments occurred because patients had either traveled for business or to the village to check on their families. Ten of the missed appointments pre-EMR but none post-EMR were due to deaths suggesting that mortality may have been averted by timely tracing. On the other hand, twenty missed appointments post-EMR were because patients were bedridden or were hospitalized.

Antiretroviral therapy reduces the occurrence of opportunistic infections and hospitalizations but this has been offset by an increasing number of people requiring life long treatment and monitoring [16] leading to overcrowding and reduced efficiency of ART programs. The volume of patients is associated with the efficiency and time each patient spends at the clinic which affects patient satisfaction and retention. Since the implementation of EMR we observed a dramatic reduction in the total time patients spend at the clinic with more significant reductions in the times waiting to see providers compared to the times spent with providers. Reduction in the time spent with providers, if not well implemented and monitored, may compromise quality of care and this will need to be further evaluated in future research. In our study, the patients newly initiated on ART and those undergoing preparation for ART spent a longer time with providers, indicating that the patient condition influences the consultation time. Adherence to appointments is associated with medication adherence [17, 18]. Following the implementation of EMR fewer patients required adherence counseling allowing the clinicians to focus on clinical consultations and to refer all patients requiring counseling to the counselors. In addition, there was a dramatic reduction in the waiting time to see the counselor as fewer patients were referred for counseling. However, the time with the counselors did not change highlighting the need for sufficient time to maintain quality adherence counseling services. There was no reduction in time spent with the records clerk, possibly because real time electronic data entry of appointment status was introduced using fewer staff. However, there was a reduction in the waiting time between the records clerk and the pill counters as patients waited less to have their files retrieved. The pharmacy staff pre-pack drugs based on a monthly prescription. Repacking of some drugs may be needed for patients who come early or miss appointments explaining long waiting times at the pharmacy pre-EMR.

Our findings should be interpreted with caution considering that ROM serves a defined catchment area making patient tracing easy and cost effective which may not be the case for other ART scale-up programs. Additionally, routine program data, with its inherent challenges, were used in the pre-EMR evaluation and many of the patients reported as lost to follow up post-EMR could actually have been dead [2, 19] leading to an underestimation of mortality during the pre-EMR period. Lastly, although the time and motion tools were anonymised there could have been reporter bias leading to underestimation of the time spent with providers.

## Conclusion

In view of the increasing pressure towards universal access there has been an increased demand for HIV services and a reduction in the ability of the health systems to sustain it.

The concurrent use of EMR with same day patient tracing can lead to a significant reduction in missed appointments and improvement in clinic efficiency allowing for more patients to be served. Prompt identification and tracing of patients who miss appointments could be an effective strategy to enhance medication adherence though adherence counseling and to minimize loss to follow up and mortality. Antiretroviral therapy scale-up efforts should include investments in record management systems, including EMR.

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## Table 1

Clinic attendance before and after implementation of Electronic Medical records and patient tracing system

| Daily clinic attendance | Pre-EMR | | Post-EMR | | *t* value |
|---|---|---|---|---|---|
| | Mean (SD) | 95% CI | Mean (SD) | 95% CI | |
| Total attendance | 68 (23) | 66–71 | 70 (17) | 68–72 | $t_{601} = 1.19^{a}$ |
| Total number of scheduled appointments | 78 (27) | 75–81 | 70 (17) | 68–72 | $t_{601} = 4.28^{b}$ |
| On-schedule appointments | 57 (21) | 55–59 | 61 (16) | 59–63 | $t_{601} = 2.73^{b}$ |
| Missed appointments | 21 (13) | 19–22 | 8 (6) | 7–9 | $t_{601} = 15.31^{b}$ |
| Early appointments | 11 (8) | 10–12 | 9 (5) | 8–9 | $t_{601} = 3.85^{b}$ |

*CI* confidence interval *P* values derived from Student's *t* test,

$^{a}$>0.001,

$^{b}$<0.001

## Table 2

Characteristics of sampled patients with missed appointments comparison of pre and post intervention

| Study variable | Pre-EMR *n* = 660 | Post-EMR *n* = 228 | *t* value* | $\chi^2$ value** |
|---|---|---|---|---|
| Age in years–Mean (SD) | 31 (12) | 30 (12) | $t_{886} = 1.10^a$ | – |
| Gender *n* (%) | | | – | |
| Male | 251 (38) | 92 (40) | | |
| Female | 409 (62) | 136 (60) | | $0.385^a$ |
| Marital status *n* (%) | | | – | |
| Married | 391 (59) | 152 (67) | | |
| Single | 103 (16) | 29 (13) | | |
| Divorced | 104 (16) | 25 (11) | | $1.320^a$ |
| Widowed | 62 (9) | 22 (10) | | |
| Medication *n* (%) | | | – | |
| ART | 428 (37) | 90 (39) | | |
| Pre-ART | 412 (62) | 138 (60) | | $0.258^a$ |
| Duration in the Program Mean (SD) | 4.5 (1.3) | 4.5 (1.8) | $t_{886} = 0.193^a$ | – |
| Duration on ART–Mean (SD) | 4.1 (0.9) | 4.4 (1.2) | $t_{523} = -0.531^a$ | – |

*$P$ values derived from Students $t$ test,

$^a$>0.001

**$P$ values derived from $\chi^2$ test,

$^a$>0.001

## Table 3

Reasons for missed appointments

| Reason | Pre-EMR (*n* = 660) (*n*/%) | Post-EMR (*n* = 228) (*n*/%) | $\chi^2$ value** |
|---|---|---|---|
| Forgot | 294 (44.5) | 34 (15) | 63.9[b] |
| Wrong appointments date captured | 188 (27.7) | 10 (4.3) | 54.2[b] |
| Travelled for business or to the village | 30 (4.5) | 38 (16.6) | 35.2[b] |
| Was at work | 18 (2.7) | 51 (22) | 91.2[b] |
| Lost to follow up | 72 (10.9) | 11 (4.8) | 7.4[b] |
| Transferred | 28 (4.2) | 0 | 9.8[b] |
| Bedridden/admitted | 4 (0.6) | 36 (15.7) | 90.8[b] |
| Gone for burial | 3 (0.4) | 11 (4.8) | 20.8[b] |
| At school | 3 (0.5) | 9 (4) | 15.5[b] |
| Died | 25 (3.8) | 7 (3.0) | 0.25[a] |
| Had drugs | 0 | 9 (3.9) | 26.3[b] |
| Others[c] | 0 | 12 (1) | – |

** *P*-value derived from $\chi^2$,

[a] >0.001,

[b] <0.001

[c] Includes those who had no reason, had an accident or were attending to a sick relative

## Table 4

Patient waiting times before and after implementation of EMR and patient tracing by provider categories

| Provider | Time waiting to see providers (min; IQR) | | | Time spent with providers (min; IQR) | | |
|---|---|---|---|---|---|---|
| | Pre-EMR (*n* = 230) | Post-EMR (*n* = 232) | *Z* value* | Pre-EMR (*n* = 230) | Post-EMR (*n* = 232) | *Z* value* |
| Registry | 18.00 (0.0–65.0) | 20.00 (8.00–49.0) | 2.84[a] | 15.00 (8.0–30.0) | 19.00(10–30) | −4.48[a] |
| Pill counters | 34.00 (16.0–66.0) | 21.00 (11.0–38.0) | −4.15[a] | 14.00 (4.0–25.0) | 2.00 (1.0–6.0) | −10.6[a] |
| Nurses | 56.00 (16.0–97.0) | 38.00 (18.0–62.0) | −5.13[a] | 18.50 (10.0–30.0) | 10.00 (4.0–20) | −4.97[a] |
| Laboratory | 15.00 (8.5–67.5) | 42.00 (16.0–68.0) | 4.35[a] | 8.50 (10.0–30.0) | 23.00 (8.0–35.0) | 3.94[a] |
| Pharmacy | 45.00 (6.0–121.0) | 11.00 (3.0–36.0) | −7.25[a] | 16.50 (11.0–23.0) | 21.00 (14.0–32.0) | 5.78[a] |
| Counselor | 26.00 (3.0–49.0) | 13.00 (2–22) | −1.54[b] | 35.00 (25.0–80) | 43.00 (31–60) | 1.56[b] |

| | Total waiting times(min; IQR) | | |
|---|---|---|---|
| | Pre-EMR (*n* = 230) | Post-EMR (*n* = 232) | *Z* value* |
| Total time spent at clinic | 274.00 (209–346) | 206.00 (159–250) | −7.94[a] |
| Waiting to see providers | 291.00 (228–353) | 94.00 (58–131) | −9.55[a] |

*IQR* interquartile range

*$Z$ values derived from Wilcoxon signed-rank test

[a]$P$ value <0.001,

[b]$P$ value >0.001