JHIDC Health Informatics in Developing Countries

www.jhidc.org
Vol.4 • No.2 • 2010

Medical record completeness and accuracy at an HIV clinic in Mozambique, 2005-2006

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Referencing this article

Alrajeh,Young, P., Elul, B., Maulsby, C., Winchell, D., Mavie B., Fernandes, R., Assan, A.R., Gorrell, S., & Nash, D. (2010). Medical record completeness and accuracy at an HIV clinic in Mozambique, 2005-2006 [Electronic Version]. *Journal of Health Informatics in Developing Countries, 4(2)*, 1-10, from http://www.jhidc.org/index.php/jhidc/issue/view/10

Abstract

Objective: Providing and monitoring HIV care and antiretroviral therapy (ART) requires complete and accurate documentation of patient visit information and laboratory test results. We evaluated medical record completeness, accuracy and reliability of certain data elements at a large public-sector outpatient HIV clinic in Mozambique.

Methods: We assessed completeness, accuracy and reliability of data elements important in the provision of HIV care and treatment which were available in paper-based medical records at enrollment and follow-up visits during two 6-month time periods (time 1: 1/05-6/05; time 2: 10/05-3/06). Records for 446 adult patients (time 1: n=209; time 2: n=237) who made enrollment visits and 274 (time 1: n=124; time 2: n=150) who made follow-up visits during the study period were included.

Results: Completeness across all data elements was 72% for enrollment and 65% for follow-up visits, while overall accuracy was 95% and 84% for enrollment and follow-up visits, respectively. However, many data elements critical to high quality care were not recorded completely or accurately at enrollment or follow-up visits, including weight, clinical disease stage, ART regimen, and to some extent, CD4+ cell count. Additionally, while the reliability of information across data sources on ART status was fair with a Kappa Statistic of 0.73, it was significantly worse for ART regimen, with the Kappa Statistic ranging from 0.12-0.59 depending on the specific tools compared.

Conclusions: The study findings highlight the need for streamlined medical records which limit redundancy across and within tools, as well as for regular data quality assessments.

Keywords: Medical records; quality assurance; Sub-Saharan Africa

Introduction

Since 2003, access to HIV care and treatment services has increased substantially in resource-poor settings, and an estimated 3 million HIV-positive individuals have now been enrolled in treatment programs [1]. By providing HIV care providers with ready access to patient information, paper-based medical records can serve to enhance quality of care. Based on generic tools developed by the World Health Organisation, paper-based medical records used in resource-limited settings generally include longitudinal patient flow charts, longitudinal pre-antiretroviral therapy (ART) and ART registers, pharmacy registers, appointment books, referral forms and outreach logs which are completed by doctors, nurses, pharmacists, social workers and, in some cases, data clerks[2] Data from these tools are often aggregated and transmitted from individual sites to district, provincial and national health authorities, and ultimately used to assess program progress and make decisions regarding future programming. Additionally, paper-based medical records serve as source documents for electronic patient-level databases which are increasingly being used in HIV care and treatment clinics in resource-poor settings.[3] As such, ensuring high data quality in paper-based medical records is fundamental to good clinical practice, program management and ultimately to policy decisions.

Data quality is judged based on completeness, accuracy and reliability. It is important that when key clinical, laboratory and psychosocial assessments are done, information from those assessments is recorded (completeness). Additionally, data recorded should correctly reflect the sources from which they are drawn (accuracy). Finally, where no “gold standard” source document is available to check the “true” value of a given data element, then multiple recordings of that element within and across documents should be consistent (reliability).

Limited information is available on the quality of medical record data in HIV care and treatment clinics in Africa. A retrospective chart review

conducted on 20% of charts at a district-level HIV care and treatment facility in Kenya showed that after implementation of an on-site clinical mentoring program, completeness of weight and WHO stage increased from 50% to 86%, and 70% to 98%, respectively.[4]. A qualitative study conducted at 12 ART sites in Malawi found the quality of data recorded at sites to be variable, but generally high and increasing with site experience. However, some forms were not updated, had errors in clinical staging and identification of HIV-related diseases, and were missing data, particularly on drug toxicities and pill counts.[5] A nationally representative retrospective cohort study which included chart abstraction of over 3200 records in Rwanda suggests important deficiencies in CD4+ cell count completeness, with 6- and 12-month CD4+ cell count information available in the records for only 49% and 35% of patients, respectively [6,7], although it is unclear whether this reflects a problem with documentation of laboratory data or rather with clinical management of patients.

As paper-based medical records continue to be the mainstay of patient and program monitoring for HIV services in resource-limited settings, we evaluated record completeness, accuracy, and reliability in 2005-2006 at an HIV care and treatment clinic in northern Mozambique, and assessed whether data quality improved during the observation period as the program matured and on-site technical assistance and supervision increased.

Methods

The assessment was done at a public sector HIV clinic located in a large health facility. Since 2004, the International Center for AIDS Care and Treatment Programs (ICAP, www.columbia-icap.org) has provided technical assistance to the HIV clinic, including clinical training and mentoring, roll-out of patient medical records, and logistics and administrative support. At the start of the study in early 2005, a total of 304 patients had been enrolled in HIV care, 78 (26%) of whom had initiated ART, and the clinic was staffed by five part-time doctors, three nurses, one medical technician, two pharmacists, two receptionists, two counselors, and two orderlies. As per national guidelines, at the time of study start, five paper-based tools served as the primary tools to monitor patient services: a visit register, intake and enrollment visit forms, clinical visit forms, medication forms, and CD4+ reports. All of these tools, except for the visit register, were stored in patient folders. All tools aside from the CD4+ reports were completed by hand during patient visits with significant overlap in information across tools, as described in Table 1. The quality of

Table 1
Data Sources

Data Source	Purpose	Staff Responsible for Completion	When Completed	Format	Location Stored
Visit Register	Includes patient demographics and ART status for all clinic visits. Patients may appear in register multiple times	Nurse, medical technician, or doctor	At every patient visit, including enrollment and follow-up	Log book format	Consultation Room
Intake and Enrollment Visit Form	Captures basic patient demographics at intake visit, and clinical history, and results from physical examination at enrollment visit	Receptionist: Demographics, Nurse: Clinical history, Doctor: Physical exam	At intake and during the enrollment visit	Four-page booklet	Patient Folder
Clinical Visit Form	Captures results of physical examination and laboratory tests done at every patient visit	Nurse, medical technician, or doctor	At every patient visit, including enrollment and follow-up	Tabular format with one column per visit	Patient Folder
Medication Form	Includes individual ART prescriptions and adherence	Pharmacist	Whenever ART is dispensed	Tabular format with one row per visit	Patient Folder
CD4+ Report	Includes CD4+ cell count values from laboratory	Printed by laboratory technician and returned to clinic	Whenever CD4+ test is requested and obtained	Printout	Patient Folder

data recorded in these tools for adult patients aged 18 or older was assessed during two 6-month time periods: January-June 2005 (time 1) and October 2005-March 2006 (time 2). For each assessment period, data quality was assessed separately for enrollment visits (in HIV care) and follow-up visits. A total of 250 enrollment and follow-up visits in each time period was deemed to provide sufficient power to detect at least a 25% change in completeness or accuracy in any single variable (α=0.05, β=0.2, p=0.5. The enrollment visit sample was selected from patients who were confirmed to be ≥18 years of age at enrollment into care and had completed their enrollment visit during one of the two time periods. Patients were included in the enrollment visit sample until 250 eligible patients were identified in each time period or the sampling frame was exhausted, whichever came first. For the follow-up visit sample, only patients who made follow-up visits during one of the two time periods were included. If eligible patients made more than one follow-up visit during the two time periods, one of those visits was randomly selected for inclusion. This sampling scheme ensured that time 1 and time 2 samples were independent; however, the same chart may have been included in the enrollment and follow-up visit sample within a given time period.

Data completeness was assessed for 11 data elements expected to be completed in the intake and enrollment form, or the clinical visit form at enrollment into HIV care, and 15 data elements expected to be completed in the clinical visit form, the medication form or the visit register during the follow-up visits (Table 2). Completeness for a given data element was calculated as the number of observed entries divided by the number of expected entries. In most cases, the number of

Table 2
Data elements reviewed for completeness at enrollment and follow-up visits.

Source	Data Element	Definition	Enrollment visit	Follow-up visit
Visit Register	Visit date	Date recorded for visit noted on clinical visit form		X
	Visit type	Visit type recorded		X
	ART status	ART status recorded		X
	Age	Age ≥18 recorded		X
	Sex	Sex recorded		X
	ART regimen	ART regimen recorded		X
Intake and Enrollment Visit Form	Age	Age ≥18 recorded	X	
	Date of Birth	Date of birth recorded	X	
	Clinic visit date	Date of first clinical examination after intake recorded	X	
	Referral section	Source of referral to clinic recorded	X	
	Referral ID number	ID number from referring service recorded	X	
	Date of HIV diagnosis	Date of HIV diagnosis recorded	X	
Clinical Visit Form	Weight	Weight value ≥0 recorded	X	X
	Karnofsky score	Karnofsky score between 0-100 recorded	X	
	CD4+ cell count	Enrollment visit: For all patients, CD4+ value ≥0 recorded +/- 14 days of enrollment visit Follow-up visit: For patients with a CD4+ report +/- 14 days of follow-up visit, CD4+ value ≥0 recorded	X	X
	CD4+ date	CD4+ test date recorded	X	
	WHO stage	≥1 opportunistic infection recorded	X	X
	ART regimen	ART regimen recorded		X
	Date of death	For patients known to have died, date of death recorded		X
Medication Form	ART prescription date	For patients on ART, date recorded		X
	Next ART pick-up visit date	For patients on ART, date recorded		X
	Remaining pill count	For patients on ART, value ≥0 recorded		X
	ART regimen	For patients on ART, ART regimen recorded		X
		Total number of elements	**11**	**15**

expected entries corresponded to the number of patient visits included in the sample. However, in the case of CD4+ cell count assessments done at follow-up visits, only patients with a CD4+ report from the laboratory were included in the denominator when calculating the CD4+ completeness rate for follow-up visits. All patients were assumed to have received CD4+ assessments at the enrollment visit and thus were included in the denominator when calculating the CD4+ completeness rate for enrollment visits. Data collection was done at least several weeks after patient visits to allow sufficient time for any CD4+ cell count results to be recorded in the patient file. Additionally, only patients known to have died were included in the denominator when calculating the completeness rate for the date of death. Similarly, only patients with medication forms indicating they had initiated ART were included when calculating completeness rates for ART prescription date, next ART pick-up visit, remaining pill count and ART regimen. An overall rate of completeness for enrollment and follow-up visits was calculated by summing the number of complete data elements per patient visit and dividing by the total number of expected data elements. This proportion was averaged thereafter across patient visits to get an overall rate of completeness for each visit type.

Table 3 lists data elements included in the accuracy and reliability assessments as well as their definitions. For accuracy a limited number of data elements were assessed. These included five data elements recorded in patient charts at enrollment and one data element recorded in patient charts during follow-up visits that had either an objective relationship with another recorded data element (e.g. age vs. date of birth) or could be compared to an objective standard (e.g. CD4+ cell count on clinical visit form vs. CD4+ cell count on the laboratory report from which it had been copied) were included. Accuracy for a given data element was calculated as the number of correct entries divided by the number of then completed entries. As was the case with completeness, an overall rate of accuracy for enrollment visits was calculated.

For reliability, three data elements all recorded in multiple locations were included. Pair-wise comparisons of the same data element across data sources (e.g. medication form vs. clinical visit form, medication form vs. visit register, clinical visit form vs. visit register, etc) were made. Reliability was calculated using an unweighted Kappa Statistic. Additionally, for ART status, a dichotomous data element, sensitivity and specificity were also used to measure reliability. As ART status was not validated with pharmacy records, we first calculated sensitivity using the medication form as the "referent" status and the visit register as the "measured" status, and then repeated the calculations using the visit register as the "referent" status and the medical form as the "measured" status. The clinical visit form was not used in the sensitivity and specificity analyses.

Table 3
Data elements reviewed for accuracy or reliability at enrollment and follow-up visits.

Assessment Type	Data Element	Definition	Source(s)	Enrollement visit	Follow-up visit
Accuracy	Age matches DOB	Age at enrollment consistent with age predicted from DOB (% agreement)	Intake and Enrollment Visit Form	X	
	Age matches DOB +/- 1 year	Age at enrollment consistent with age predicted from DOB, +/- 1 year (% agreement)	Intake and Enrollment Visit Form	X	
	Date of HIV diagnosis matches test report	Date of diagnosis recorded in chart consistent with date on test report (% agreement)	Intake and Enrollment Visit Form, HIV Test Report	X	
	CD4+ cell count matches CD4+ report	CD4+ count recorded on clinical visit form consistent with CD4+ count on test report (% agreement)	Clinical Visit Form, CD4+ Report	X	X
	CD4+ test date matches CD4+ report	Date of CD4+ cell count recorded on clinical visit form consistent with date on test report (% agreement)	Clinical Visit Form, CD4+ Report	X	
Reliability	ART status	ART status of patient consistent on medication form and visit register (Kappa, sensitivity, specificity)	Medication Form, Visit Register		X
	Regimen	ART regimen consistent on medication form and visit register, medication form and clinical visit form, clinical visit form and visit register (Kappa).	Medication form, clinical visit form, visit log		X
		Total number of elements		**11**	**15**

Data were abstracted directly into an Access database by a trained data clerk. All data cleaning and analysis was performed in SAS version 9.1.3. Based on classifications used in a previous paper examining concordance across medical records [8], findings for completeness, accuracy, reliability, sensitivity, and specificity were categorized as excellent (91-100%), good (76-90%), fair (60-75%), and poor (<60%). Data were analyzed separately for time 1 and time 2 for comparison purposes and pooled in order to assess overall levels of completeness, accuracy and reliability. Changes in completeness and accuracy over time (time 1 vs. time 2) were tested using two-sided student's t-tests assuming unequal variances. Ethical approval was obtained from both the Columbia University Institutional Review Board and the Mozambican Bioethics Committee.

Results

Medical records for all 446 (time 1, n=209; time 2, n=237) adult patients whose folders could be located and were confirmed to have completed an enrollment visit in one of the two study periods were included in enrollment visit sample. Two-hundred and seventy-four (time 1, n=124; time 2, n=150) of those patients made at least one follow-up visit during the assessment periods and their records were included in the follow-up visit sample (Figure 1).

Pooled samples: completeness and accuracy

Enrollment visits

As shown in Table 4, overall completeness for data elements assessed during enrollment visits across the two study periods was fair, with 72% of expected data elements completed. Completeness varied greatly by data element, ranging from under 1% for CD4+ test date to nearly 100% for patient age. Overall accuracy for enrollment visit data was 95%. Accuracy of CD4+ cell count data on the clinical visit form was excellent, with 96% of values consistent with those on the CD4+ laboratory report, while accuracy for patient age was good, with 78% of values consistent with age when calculated from the patient's date of birth. Accuracy of the date of the CD4+ assessment noted on the clinical visit form could only be assessed for the two patients for whom dates were recorded on that form and in both cases those dates did not match those on the CD4+ report from the laboratory.

Follow-up visits

Overall completeness for data elements assessed during follow-up visits across the two study periods was fair (69%) (Table 5). The majority of data elements pertaining to follow-up visits which were assessed in the visit register had excellent completeness, with levels greater than 95% noted for patient sex, age, ART status and visit type. The completeness of dates of visit and specific ART regimens prescribed was good, but recorded less frequently, about 80% of the time. Additionally, completeness of information related to follow-up visits was generally significantly worse in the clinical visit form and the medication form, with several data elements critical to high quality care poorly documented, including weight (43%) and WHO stage (30%), 78% of the patients who had CD4+ cell count measurements done during their follow-up visit had the results recorded in their clinical visit form. With regard to data accuracy, which was assessed only for CD4+ cell count data, the values noted in the clinical visit form were consistent with those on the laboratory report 84% of the time.

Pooled samples: reliability

Reliability of patients' ART status was assessed across the medication form and the visit register for all follow-up visits pooled across the two study time periods (Table 6). When the medication form was compared with the visit register, the Kappa Statistic, which takes into account chance agreement, was fair at 0.73. When sensitivity and specificity were calculated using the medication form as the gold standard, sensitivity was excellent (100%) and specificity was good (86.3%). Using the visit register as a gold standard specificity was excellent (100%) while sensitivity was only fair (66.2%) (Table 6).

Reliability of ART regimen data across the three data sources assessed—medication form, visit register, and clinical visit form—was significantly worse, with the Kappa Statistic ranging from 0.02 when comparing data from the clinical visit form to that on the visit register, to 0.58 when comparing data from the medication form to that on visit register (Table 6).

Comparing over the two time periods: completeness and accuacy

Enrollment visits

As shown in Table 4, comparison of overall data completeness recorded at enrollment visits between time 1 and time 2 shows a small but statistically significant increase over time (6%, p<0.001). Substantial improvement was seen in completeness of WHO stage and date of HIV diagnosis over time, with increases of 36% (p<0.001) and 30% (p<0.001), respectively. A smaller but still significant increase in data completeness was also observed for date of birth between time 1 and time 2 (6%, p=0.004). Completeness of weight data was low in both periods and decreased significantly over time (time 1: 35%; time 2: 21%; p=0.001). While there was no significant change in overall accuracy of enrollment visit data over the two time periods, accuracy between age and date of birth at enrollment increased significantly (22%, p<0.001).

Follow-up visits

No significant change over time was observed in the overall completeness of information recorded in follow-up visits between time 1 and time 2 (2%, p=0.4222) (Table 5). While large improvements in completeness of weight (29%, p<0.0001) and WHO stage (19%, p=0.0006) information were noted over time, both data elements were poorly completed in both time periods. Among patients who had CD4+ cell count assessments, documentation of test results on the clinical visit form increased significantly over time from 72% to 96% (p=0.001). Completeness of record-keeping for ART status (-25%, p<0.001) and ART prescription date (-12%, p=0.024) at follow-up visits decreased significantly over time. No significant temporal change was observed in completeness of any data element captured in the visit register. With regard to the accuracy of data captured at follow-up visits, a

comparison of CD4+ cell count values from patient charts and laboratory reports suggests a decrease in accuracy for this data element between time 1 and time 2 (-20%, p=0.048).

Comparing over the two time periods: reliability

With regard to trends in data reliability over time, no significant change was observed in the Kappa Statistic for ART status (<1%, p=0.463) between time 1 and time 2 (Table 6). However, reliability of ART regimen information documented on the clinical visit form and the visit log decreased significantly over time as shown by a -0.38 decrease in the Kappa Statistic (p<0.001) (Table 6).

Table 4
Enrollment visit data completeness and accuracy rates.

		Pooled sample n[1]=446	Time 1 n=209	Time 2 n=237	
		%	%	%	p-value
Completeness	**Source: intake and enrollment form**				
	Age	99.8	99.5	100.0	0.319
	Date of birth	95.5	92.3	98.3	0.004
	Clinical visit date	99.3	100.0	98.7	0.083
	Referral section	97.5	97.1	97.9	0.609
	Referral ID number completed	53.9	60.0	52.4	0.787
	Date of HIV diagnosis	83.9	72.7	93.7	<.0001
	Source: clinical visit form				
	Weight	27.1	34.5	20.7	0.001
	Karnofsky score completed	68.4	66.0	70.5	0.317
	CD4+ cell count	27.8	23.9	31.2	0.085
	CD4+ date	0.8	2.0	0.0	0.322
	WHO staging	70.4	51.7	86.9	<.0001
	Overall completeness[2]	72.0	68.9	74.6	<.0001
Accuracy	**Source: intake and enrollment form**				
	Age matches DOB	78.4	66.2	88.4	<.0001
	Age matches DOB +/- 1 year	94.1	93.2	94.9	0.486
	Date of HIV diagnosis matches test report	94.9	94.7	95.1	0.895
	Source: clinical visit form				
	CD4+ cell count matches CD4+ report	96.0	96.0	96.0	0.988
	CD4+ date matches CD4+ report[3]	0.0	0.0	N/A	N/A
	Overall accuracy[4]	94.8	94.7	94.8	0.936

Footnotes

1. Denominator is less than reported N for variables whose completion is conditional on other variables.
2. Overall completeness score includes all 11 variables.
3. The accuracy of CD4+ date in the clinical visit form could only be assessed for the 2 patients for whom dates were available in the clinical visit form during time 1. All dates were missing for the sample patients in time 2.
4. Overall accuracy includes 3 variables: age matches DOB +/- 1 year, date of HIV diagnosis matches test report, and CD4+ cell count matches CD4+ report. CD4+ date matches CD4+ report was excluded due to significant missing data for CD4+ date in the clinical visit form.

Table 5
Follow-up visit data completeness and accuracy rates.

		Pooled sample n[1]=274	Time 1 n=124	Time 2 n=150	
		%	%	%	p-value
Completeness	**Source: visit register**				
	Visit date	79.6	83.1	76.7	0.188
	Visit type	99.5	100	99.1	0.319
	ART status	97.7	98.1	97.4	0.742
	Age	98.2	99.0	97.4	0.359
	Sex	96.3	95.1	97.4	0.389
	ART regimen	80.9	80.0	81.8	0.852
	Source: clinical visit				
	Weight	43.1	27.4	56.0	<.0001
	CD4+ cell count	78.1	72.1	96.4	<.0001
	WHO staging	29.6	19.4	38.0	0.007
	ART regimen	39.2	40.0	36.4	0.835
	Date of death	66.7	66.7	N/A	N/A
	Source: medication form				
	Prescription date completed	22.6	29.0	17.3	0.024
	Next visit date	21.0	11.1	34.6	0.037
	Remaining pill count completed	35.5	36.1	34.6	0.905
	ART regimen	100	100	100	N/A
	Overall completeness[2]	60.7	59.7	61.5	0.422
Accuracy	**Source: clinical visit**				
	matches CD4+ report	84.3	90.3	70.4	0.048

Footnotes

1. Denominator is less than reported N for variables whose completion is conditional on other variables.
2. Overall completeness score includes all variables except date of death as so few deaths were recorded.

Discussion

This study assessed the completeness, accuracy and reliability of several key data elements recorded in national patient record forms and logs over time in a large public-sector HIV clinic in Mozambique. Completeness of record-keeping for examined data elements taken together was found to be fair for enrollment (72%) and follow-up (66%) visits, accuracy to be excellent at enrollment (95%) and good at follow-up (84%) visits, and reliability to be fair for ART status (kappa=0.73) and poor for ART regimen (kappa=0.02-0.59 depending on sources). Data completeness and accuracy were higher for enrollment visits than for follow-up visits. Additionally, some improvement in overall data quality was observed between the two study assessment periods. This may have resulted from increased record-keeping skills among staff as the program matured, or to specific program enhancement and service organization activities that occurred between the two time periods, such as the introduction of paper-based pre-ART and ART registers and appointment systems.

While overall completeness of record-keeping at both enrollment (72%) and follow-up (66%) visits was fair, there was great variation across specific data elements such that some data elements were rarely completed and others nearly always completed. Incomplete documentation in the clinical visit form of CD4+ cell count measurements and of WHO stage at enrollment visits was particularly concerning as such information is essential to identifying patients eligible for ART as early as possible and ideally at enrollment into HIV care. Indeed, several recent studies have highlighted the increased risk of mortality among eligible patients who do not begin ART in a timely manner [9]. Similarly, while CD4+ completeness and accuracy was relatively high at follow-up visits, incomplete documentation of WHO stage during those visits suggests problems may persist with identification of patients newly eligible for ART for

returning patients, although we cannot rule out that some of these patients were already on ART and thus would not require disease staging. Additionally, poor documentation of weight at both enrollment (27%) and follow-up (43%) visits may be indicative of problems with patient monitoring, especially as weight loss or low body mass index may indicate untreated medical conditions, or may qualify patients for nutritional support services.[10]

One of the key findings from this study is the multiplicity of forms and registers used in the HIV clinic and the degree of redundancy across and within tools. Issues noted with data completeness, accuracy and reliability highlight the need for streamlining paper-based medical records and eliminating redundancy. For example, while ART regimen information was recorded on only approximately one-third of clinical visit forms, it was complete on all medication forms, and one-third of CD4+ cell counts done at follow-up visits were found to have been inaccurately transcribed from laboratory reports to clinical visit forms during the second study assessment period. While it is advantageous for providers to have access to all essential information in one single form, the need for repeated documentation of the same information can only hamper centralized record-keeping. If information must be recorded in multiple locations, ensuring reliability is essential to maintain confidence in the information.

Great interest has been recently demonstrated in the establishment of electronic data systems in resource-limited countries as a complement to paper-based systems. However, as many electronic systems rely on paper-based medical records for their inputs, ensuring high quality paper records and comparing data between paper and electronic records remain critical activities. Since this study was performed, an electronic patient-level database has been introduced at the site and routine data quality assessments have been introduced in order to ensure data quality of both electronic and paper systems.

The study has several limitations. First, we were unable to validate patient ART status with pharmacy records and thus calculated sensitivity and specificity using available data sources as the referent measure. Second, while completeness of CD4+ data was assessed only for patients with CD4+ reports from the laboratory for follow-up visits, for enrollment visits, we assumed that all patients received CD4+ assessments (as per national guidelines for clinical assessments upon enrollment into HIV care) and thus cannot definitely parse out problems due to poor compliance with national guidelines and poor documentation. Similarly, with regard to completeness of WHO staging at follow-up visits, we are unable to identify which patients initiated ART by the time of their follow-up visit and thus would not require further disease staging. Additionally, while comparison of data from two time periods allowed the detection of changes in data quality over time, we cannot make causal inferences about which program characteristics contributed to the observed changes. Furthermore, the time period between assessments was quite short. Finally, as data collection was conducted during the first 18-months of the roll-out of HIV care and treatment services at the site, we did not assess data quality once site staff had gained substantial experience in the provision of comprehensive HIV services.

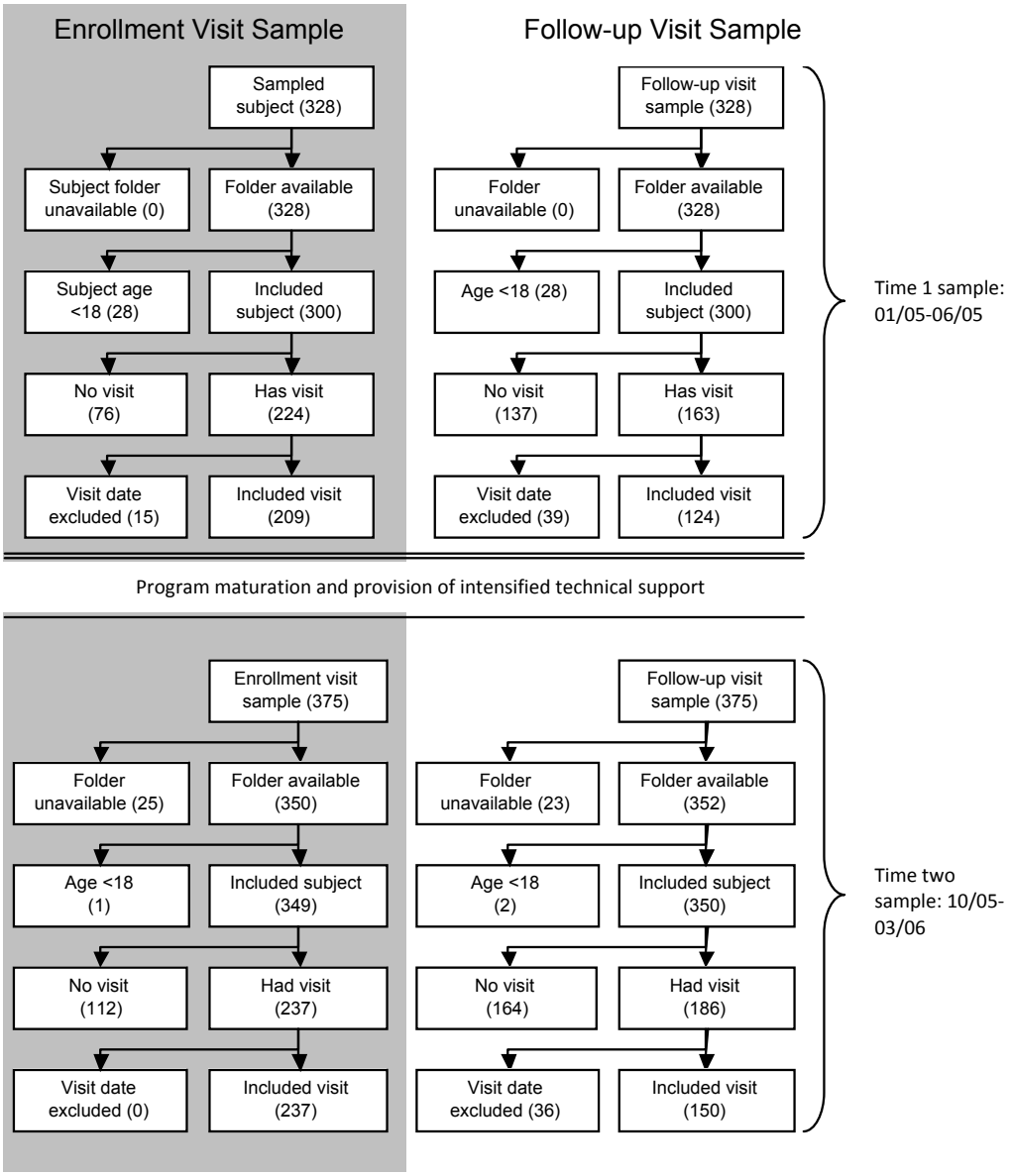
Conclusions

Achieving high data quality is challenging in any setting and especially in resource-poor settings where experience with longitudinal patient records is limited. Improving and ensuring high data quality of paper-based medical records is increasingly important as clinics adopt electronic systems which draw from paper systems in an effort to ease management of large patient caseloads. A number of simple activities would likely enhance data quality at HIV care and treatment clinics in these sites and others in Sub-Saharan Africa. First, medical records should be modified to be as simple and easy to use as possible, and redundancy across and within forms should be minimized, as the need for redundant documentation by providers is likely to cause frustration as well as a decrease in their overall productivity. Second, clear systems for data flow in which specific individuals are responsible for completing specific tools or data elements should be developed. Additionally, with streamlined tools, providers are less likely to view record keeping requirements as a burden and a distraction from patient care. Training for providers should emphasize that complete, accurate and reliable record keeping is a key component of the provision of high quality care. Training clinic staff to use routinely collected data for program improvement would likely also enhance data quality. Indeed, without feedback to providers regarding information and data collected or clear evidence of the value of the data, their full engagement in this process is unlikely to be achieved. Lastly, simple procedures for routinely assessing data quality should be implemented and results shared with data clerks, nurses, providers and other clinic staff.

A. Statistical Appendix

A latin square sample design was implemented to allow simultaneous comparisons by visit type and by pre- and post-intervention.

Figure 1
Sample flow diagram



Acknowledgements

We are grateful to the staff of the Nampula Provincial Health Department and the HIV Clinic; Drs Pascoa Wate and Olimpio Durão Mola of the National Directorate of Medical Assistance within the Ministry of Health, and Drs Josué Lima and Denise Arakaki-Sanchez, and Mie Okamura of ICAP-Mozambique for their support. We also thank Ana Henriqueta for assistance with data entry, and Wafaa El-Sadr, Anne Paxton, Lisa Nelson, Amy Dubois, Mathew Rosenthal, and Deborah Horowitz for their comments.

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