

ART Software Applications

Software Evaluation Parameters

Software Evaluation Parameters

The ART Software has been evaluated on multiple parameters to give the full dimension of each. The following is a description of each of the parameters and an explanation of their relevance.

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Contact Information and Developed For

This indicates who to contact for further information to answer questions. The “Developed For” listing can give you insight into the target purpose of the software.

Current Users

Describe group of current users where implemented (number of sites, geographical location, type of facility, approximate size of patient population), generalized vs. HIV specific care facility, point of entry of HIV patients.

The number of sites and number of patients is an important indicator that the system is available and ready for deployment. It is an indicator of the maturity of the software. Systems that have few sites and patients will likely lack maturity and may require additional work on the software to make it fully functional in your situation.

If the system can also be used for general medical care and not just ART, it is likely to be a more full featured and robust system with a wider range of uses. However, check the ART specific features of the software to make sure it also includes the required ART features.

Programmatic Functionality

This section lists specific functions of the software. Check here to make sure the software does what you need.

Patient Care Tracking

Functions that support individual patient care.

Patient ID

Description of the patient ID features and formats supported. Also, what tools are available to prevent duplicates and search for records.

Identifying individual patients accurately is central to the proper functioning of the software. The main tool for this is a patient identification number. Identification numbers may be assigned by various clinics and agencies. Patients may have more than one identification number (clinic, national, HIV register, etc.) The software should offer flexible support of multiple patient identification numbers to accommodate your current schemes.

Unique ID Tools

Describe tools available to prevent duplicate Ids, prevent split records, and locate patients in db.

It is crucial that each patient have a unique record and that each patient has only one record. The consequences of duplicate identification numbers and multiple records per patient (split records) are incomplete and inaccurate information which can lead to inappropriate care.

Central to unique ID tools are methods to locate patients using various criteria such as name, address, identifying numbers, age, sex, and related individuals. The more of these factors that can be included,

the better the chance of uniquely identifying a patient.

Family or Contact Data Record Linking

Links to other records in the system to record family groups or disease contacts. Describe type of linking.

Family and contact groups are important for purposes of providing care and support services and also for contract tracking for HIV and TB as well as other communicable diseases. A system that supports the linking of individuals in the medical record can help coordinate care and improve outcomes. It is preferable that this linking be done by forming associations between individual patient records with a place to note the type of relationship. This type of linking maintains the relational integrity of the databases. A less preferable method is to create separate lists of family and contacts within individual patient records. This method is difficult to keep up to date as individuals change.

Demographics

Demographic fields such as address, contact information, birth date, sex, other ID numbers, etc. List fields that are supported.

Demographics refers to patient identifying and location information. It is essential to adequately identify the patient and the patient's location. The software should allow for a wide variety of identifying information. Some of this information will need to be customized to the region of the patient since methods of identifying location vary and the format of identification numbers and other information such as dates also have regional differences. The software should be checked carefully to ensure that it will accommodate the necessary information or that it can be easily modified.

Pt status

Current patient status indicator and values that are supported. Examples include eligible for treatment, receiving treatment, deceased, lost to follow-up.

Patients will have a variety of administrative states at various times from registration as HIV positive, through eligibility and preparation for treatment, and through various programs of care. The definition of these states will often be defined for a specific program or region. The software should support a flexible definition of multiple patient states that can be updated for regional and program requirements.

Contact tracking

Fields to list contacts for communicable disease contact tracking.

Case contract tracking is particularly important for communicable diseases such as HIV and tuberculosis. It is important to ensure that contacts receive appropriate information and care. If the software has specific fields to facilitate contract tracking, it can improve management.

Appointment scheduling

Scheduling of patient appointments. Indicate capabilities such as multiple referrals, flags and reminders for overdue clients.

In the management of HIV/AIDS which is a chronic disease which requires continuous treatment, the

management of patient appointments is crucial. Patients must be scheduled at appropriate intervals to ensure that they receive proper care and medication continuity. In addition, the important function of patient follow-up can be greatly facilitated by an electronic appointment system. Appointment scheduling systems facilitate the smooth flow of patients by matching patients to staff availability. In addition, patients who miss appointments and be flagged for personal contact to ensure they receive continuous care and do not run out of medication.

Medical History

Indicate capabilities. A complete medical history includes social history, family history, patient past medical history, immunizations, toxic exposures, habits, review of systems, and history of present illness.

Each patient's past medical history is important and must be readily available to ensure that they are receiving appropriate care. Often the most pertinent facts of the patient's medical history are presented on a "summary sheet" for review at the point of care. The software should allow for a complete and flexible recording of each patient's medical history. The history is typically recorded in categories such as social history, family history, patient past medical history, immunizations, toxic exposures, habits, and review of systems. The system that is defined for use in any region will depend on local practices. Software selection should be dependent on ensuring that it can support the required format and information.

Behavioral history (incl. STD risk factors)

Specific behavioral history relating to STD/HIV risk factors. Indicate risk factors tracked.

Since HIV is a sexually transmitted disease and can also be transmitted by contact with bodily fluids, it is important to track specific behavioral risk factors so that patients and contacts can be properly educated to prevent transmission of disease. In addition, certain risk factors can also alert the clinician to important co-morbidities such as hepatitis, and tuberculosis. The software should have a section where behavioral history can be recorded in a flexible format that will meet regional and program requirements.

Allergies

Includes drug, non-drug, and environmental allergies. Indicate if support flags to warn on Rx?.

Allergies are important to ensure patients receive proper care. The software should support recording and appropriate display of allergy information. This is especially important for drug allergies which may require modification of treatment protocols. Typically drug allergies are displayed on a patient summary sheet for use at the point of care.

Physical exam

Recording of the physical exam by organ system. Indicate system for recording exam and number of elements. Does the neurological exam include Karnofsky score?

The physical exam is essential to care of HIV patients since it guides clinical therapy and can alert the clinician to important opportunistic infections. The exam should be performed and recorded at each

clinical encounter. The software should permit fast and easy recording of significant positive and negative clinical findings. The software should also permit an easy review of prior exams so that a patient's clinical progress can be monitored. Software should permit the flexible recording of priority exam information and this facility should be easily customized to meet regional requirements and protocols. The neurological Karnofsky score is important for tracking the neurological impact of HIV and treatment and the software should support this explicitly.

Pregnancy

Pregnancy history (Gravida/Parity), complications, current pregnancy dates and exam/lab tracking, EDC.

Pregnancy has important implications for patients who are HIV positive. The most crucial is to initiate a protocol to prevent mother to child transmission (PMTCT) of the HIV virus. In addition, pregnancy is a significant stress and an important time to ensure that both mother and child receive the best care and support services to achieve the best possible outcome. In order to do this, it is crucial to record the pregnancy history (including prior complications and outcomes) and also the details of the current pregnancy including detailed exam and laboratory results. Access to this information will help ensure that clinicians can provide the best care. In addition, the software should provide specific features to ensure that the PMTCT protocol is being followed including prompts to ensure that the appropriate peri-delivery treatment and patient education is being followed.

HIV staging

HIV staging by WHO staging system or other staging system used.

The WHO HIV staging protocol is crucial to patient management and an important factor in monitoring the progress of the disease and treatment. The software should support this staging system explicitly. In addition, other HIV staging systems to meet regional requirements may be optionally supported.

TB specific Dx and Tx

Tuberculosis screening and management features including symptoms screen, lab orders and results, resistance testing, and treatment.

It is imperative that the software include features to support the diagnosis and treatment of tuberculosis. Since estimates of coexisting TB and HIV infection run in the neighborhood of 50%, all HIV patients must be monitored closely for tuberculosis and treated appropriately. Treatment includes that for active disease as well as prophylaxis. The TB status of the patient should be assessed at each clinical visit and appropriate treatment and prophylaxis should be recorded.

STD specific Dx and Tx

Sexually transmitted disease (STD) exam, lab, diagnosis and treatment.

The existence of other sexually transmitted disease is important in the management of HIV patients since this can affect disease transmission and can be significant opportunistic infections. The software should record the results of STD exams, laboratory, diagnosis and treatment.

Malaria specific Dx and Tx

Malaria tracking including lab, resistance, and treatment.

Malaria is an important opportunistic infection for HIV. In malaria endemic areas, HIV patients are often co-infected with malaria and this can affect their ARV treatment response. Malaria infection needs to be monitored throughout ARV treatments as it may not be apparent until the patient has been on ARV medication. Malaria prophylaxis may also be part of the treatment protocol. The software should include specific features to ensure that the patient's malaria diagnosis, treatment, and prophylaxis status is monitored and recorded continuously at clinical visits.

ARV Tx specific functionality

Describe specific functionality to address ARV treatment and advice.

HIV positive patients will progress to the point where they receive anti-retroviral (ARV) therapy (ART). Current protocols for ART demand a high degree of clinician and patient communication and patient education. The protocols also specify criteria for monitoring treatment and changing medications when appropriate. It is essential that the details of patient ART be recorded and available for review and assessment. Software should permit treatment regimens to be easily recorded and reviewed. It should allow regimens to be modified as protocols change. Adverse reactions, complications, and resistance to medications should be recorded.

An fertile area for advanced software is to incorporate treatment advice into the software so that the software can evaluate the patient's condition and response and make suggestions of appropriate treatment based on approved protocols. These advanced treatment advice systems can improve patient care. However, they are difficult to design and implement and they must be modifiable to adapt as protocols change.

PMTCT information tracking

Specific functionality to track Prevention of Mother to Child Transmission status and indicators. Indicate information supported such as initial information, counseling and testing, post test counseling, treatment at delivery, and child post-partum testing.

The opportunity to prevent mother to child transmission (PMTCT) of the HIV virus during pregnancy and delivery is an important intervention. PMTCT programs have been developed with a specific protocol of patient testing, education, and treatment. If the PMTCT protocol is followed carefully, the transmission of HIV to the child is dramatically reduced. Therefore, HIV patients who are pregnant should be enrolled in the PMTCT protocol. The software should monitor the specific steps of the PMTCT protocol to ensure that they are followed properly and that patients receive appropriate care and instruction. Since the various actions of the protocol take place of a period of time before, during, and after delivery, software can play an important role in ensuring that all of the steps are followed properly.

Other disease specific exam info

Indicate any other specific diseases that are explicitly covered and the information that is recorded for each.

Software may include features for monitoring diseases other than those covered above. These may

include opportunistic infections or related conditions. Software should be evaluated to determine whether or not these additional features will be of use in the program. The flexibility and customization features of the software can be important factors in making it useful.

Problem list (conditions and status)

Medical problem list with date of onset, resolution. List any specific nomenclature supported.

The concept of a “problem list” is important in the long term care of patients and is significant in chronic disease management. The problem list is an accounting of an individual patients current medical problems (diagnoses) and can also include resolved problems. It is important to maintain this and update it at each clinical visit. It is an efficient method of making sure that all of a patient's problems are assessed at each clinical visit. The problem list is often presented as part of the patient summary sheet for use at the point of care. Software that supports a patient problem list can lead to improved patient care. The problem list software should allow for easy entry and update of the conditions on the list and should keep track of the dates of the activity of each patient problem.

Problem list software can use free text or problem information coded with a specific coding system such as the WHO ICD or the Read codes. Free text is generally discouraged since it can be difficult to aggregate for analysis but often the diagnosis codes are too cumbersome for efficient use. When dealing with a specific chronic disease such as HIV infection, it is often possible to put together a short list of specific “problems” that can be selected in the software. This can lead to efficient software use and uniform coding which facilitates analysis. Any coding system should be carefully evaluated for use in the specific environment.

Referrals (counseling, ancillary care)

Referral for specialized treatment tracking including results of referral.

Since HIV infection is a long term disease which requires a variety of responses over the duration, a system that can manage referrals for counseling or ancillary care can be very useful. A good HIV management program will include a wide variety of services including counseling, contact follow-up, family support services, specialist medical services and others. It can be difficult to track and manage these services without the use of software. Software that has the capability of scheduling, tracking, and following up on these additional services will improve patient outcomes. The software should include the ability to classify the category of service, the response, responsible agencies or individuals, and outcome.

Consultations (medical)

Medical consultations with results and recommendations.

As HIV progresses, various specialist medical consultations may be required which go beyond the primary clinical caregiver. Often these consultations may be conducted at a time and place distant from the primary care site. It is important to schedule and track the results of these consultations with recommendations so that the patient can receive the best care. Software that can track these referrals and permit recording of recommendations and follow-up can improve patient care. This software feature may be included in the “Referrals” section (above) or the software may include a separate section for medical consultations.

Encounters (LMR)

Patient encounters (longitudinal medical record) including dates, reason for visit, exam, diagnosis, treatment, services, medications, lab, x-ray, follow-up.

Patient encounter tracking is the essential core of the longitudinal medical record (LMR) and is essential for chronic disease management. Each patient encounter must be recorded and include information on activities that were conducted at the time. Encounters can include brief “nurse visits” where basic information is collected and medications refilled as well as more intensive clinician visits where more information is collected and analyzed. Together, these individual encounter records constitute an important clinical record of the patients care and treatment and response to treatment over time. Software that collects this information and presents it for review can greatly improve patient care by giving clinicians a good picture of the patient's history and response to treatment. The encounter information is also an important source of information to monitor the performance of the health system and can be used to improve patient care protocols.

Software should be flexible and customizable to include the information that is important for your protocol and program. It should be easy to use so that data entry does not become a burden. It should use coded values wherever possible to improve the reliability of the data.

Many systems are using the WHO Patient Monitoring Guidelines as an essential data set for ART. Often this essential data set is modified to accommodate regional protocols and programs.

Vital signs

Vital signs such as temperature, pulse, BP, and weight for each encounter.

The basic set of vital signs are important information for monitoring patient status. The software should include the capability to easily record this information at each encounter. Vitals such as weight can be presented as a graph which some people find useful in monitoring initial response to ART.

Lab

Lab ordered and results, provision for review of results over time and comparison of multiple lab values. Does the system produce graphs of results?

There are several laboratory tests which can be important for monitoring patients with HIV infection. It is important that these be recorded in the record and be available for easy review. Often laboratory results lend themselves to graphical presentation which improves their readability by making it easier to see trends. Software should record the date of each laboratory test and the results. Advanced software can also flag abnormal values or trends for the attention of the clinician.

Lab results interpretation

Automatic checking of lab results for abnormal values or combinations of values.

Information that is entered into computer software has the advantage of being available for analysis and decision making. Simple computer analysis can include checking laboratory values for abnormal results. More advanced analysis can include trend analysis or checking multiple values for coherence or abnormalities. In advanced systems, software analysis can look at related clinical information and use this to improve the analysis.

When selecting software, check how easy it is to configure this analysis software. Changes will need to be made to the parameters and rules for analysis depending on regional or local protocols and lab methods so the software should be easy to configure the software to meet changing requirements.

Lab electronic linkage

Provision to load external lab results to EMR automatically.

Often laboratory results are available in electronic form. If these results can be set up to be automatically transferred into the clinical software, it will improve the speed, accuracy, and completeness of laboratory information. This linkage must be carefully designed and implemented with proper protocols to ensure unique patient identification and reliable communication of information. Software that offers this feature can improve your information system.

Radiology

Radiology ordering and results; text results; image results.

Radiology results are a special case of information that should be integrated into the patient record. Software to record this should at a minimum record the date, type radiology exam, and results in text format. More sophisticated software can store radiology images for retrieval. However, this requires a large amount of storage space and can place a significant technical hurdle to implementation. For most purposes, the basic radiology information (without images) is sufficient.

Medication

Record of medication; dates start and end or duration; graphing of medications. Drug interactions; drug dosing; standard treatment regimens.

Medication tracking is crucial to managing ARV patients. The treatment of AIDS requires the prescribing and monitoring of a complex combination of drugs according to a specific protocol. Current therapy decisions depend on prior medication history, response, adverse reactions, and resistance.

Software should be able to track medication by individual drug and drug regimen (combination) including dates and dosage. Particular attention should be made to the ease of entry of this complex information as well as viewing of medication history. Graphs of medication regimens, individual drugs, and gaps in treatment can be very useful.

Drug regimes are an important concept in ART. A drug regimen is defined as a specific combination of drugs (typically three drugs). Patients will typically start with a certain regimen and this may change over time as the patient develops adverse reactions or resistance.

Software must include the ability to define standard drug regimens and to allow exceptions and substitutions. As protocols will change over time, these regimens must also be easily changed. In order to view individual patient drugs, the regimen information should include the names and dosages of each of the individual drugs in the regimen. This information is important as it also permits later analysis of individual drug response.

When selecting software, particular attention should be paid to the flexibility of the drug regimen features to ensure that they can be easily customized to regional or program needs. In addition, the ease drug data entry is important since this is an important function that will be performed frequently.

If this data entry procedure is complex, confusing, or difficult, the data quality will suffer.

Other

Any other clinical features of note.

Software designers are endlessly inventive and many have developed useful features to improve the capture or display of information. Evaluate these features carefully in your use environment to gauge their usefulness.

Individual Patient Reporting

What type of individual patient reporting is available for use in the clinic. This may include a patient summary sheet or more complete report. Is it user configurable.

In the above discussion, reference has been made repeatedly to a “patient summary sheet” or to the display of individual patient information. It is important to remember that the primary purpose of collecting this information is to use it and an important use is at the point of care with the individual patient. The point of care is the place where the clinician makes decisions on patient care and it is crucial that the clinician have complete and accurate information.

Software that can present individual patient information in a clear, convenient, and useful format will improve patient care. This may be on a computer screen (if these are available for patient interaction) or more likely in printed paper format that can be carried to the patient at the time of the encounter. It is extremely important that this individual patient reporting be evaluated carefully to ensure that it meets regional and program needs and protocols for good patient care. One should also evaluate the ease of modifying the content and format of this information to accommodate changes as clinical care evolves.

Guidelines for care

Standard guidelines

Provision to include standard care and treatment guidelines in software and to have the system prompt with this information.

Access to standard guidelines in the context of individual patient care can improve compliance with the guidelines and patient outcomes. This is a simple advice system but it can bring about improved patient care.

When evaluating a guideline advice system, one should consider when and how the information is presented. If the system produces a printed patient summary sheet that is used at the point of care, the guideline information should also be printed on the the patient summary sheet.

One should also consider the ease of modifying and updating this information as treatment guidelines change.

Customized patient advice

Software makes an assessment of patient condition and current treatment and makes recommendations.

One of the advantages in having an electronic medical record is that the information in the record can be analyzed automatically and used to give treatment advice. This is a form of “expert system”. The treatment advice can be something as simple as showing the standard treatment protocol or it can be more a more complex system where the computer evaluates individual patient information and tailors advice to the specific condition.

This is an advanced software function and may not be available in most software. If it is present, it must be capable of being modified to meet the specifics of regional treatment protocols. The system should be investigated to determine the ease of adding and modifying “rules” for giving treatment advice. This function can improve the quality of care but it will require an effort to set up and maintain.

Patient take home information

Information for patients to take home regarding their diagnosis, care and treatment.

Another advantage of the electronic medical record is that it can analyze an individual patient record and produce patient advice that is tailored to the specific status of that patient. This “individualized patient advice” can improve patient knowledge and cooperation and improve their care. This information should be reviewed with the patient at the clinical encounter and then given to the patient to take home as a reminder of the advice.

The amount of customization and flexibility of this patient advice system will vary with the software and should be evaluated carefully for applicability within the regional context. An important factor to consider is how easily the information can be customized to meet local requirements and how easy it is to customize the criteria for distributing custom advice.

Decision support / expert systems

Describe any decision support or expert system features in the software including the degree of user configuration possible.

A decision support system is an advance expert system that can draw information from the patient record, apply rules that have been designed by experts, and give specific patient advice. This is a step more advanced than the customized patient advice system. In evaluating this feature, it is important to gauge the ease of customizing the analysis to meet your local requirements.

Clinic Management

Appointment scheduling

Group scheduling of rooms, practitioners, and patients.

In order to improve the efficiency of service delivery, it is helpful to distribute the workload to match the human and physical resources. A computer scheduling system can help with this task. It makes it easy to gauge workload per clinician and allocate facilities. It can monitor overbooking as well as underutilization.

When evaluating this feature, carefully assess the ease of making an appointment as well as the tools that monitor resource utilization.

Service statistics

Clinic service statistics for management.

Basic clinic service statistics are an essential management tool to improve the efficiency of delivery of services, gauge productivity, and advocate for appropriate resources. Electronic medical record software should be able to produce this information from the encounters that are entered. This is an example of “free” information that comes as a side benefit of maintaining an electronic system. Evaluate this feature by the flexibility and customization available in the reports.

Clinic attendance and services patient register

Patient register

Patient register and the information that is recorded.

Electronic medical record software should be able to produce a “register” of patients. The register is a master patient list. The patient register should be able to be filtered by any of the information (such as patient status, demographics, clinical status, clinician, etc.) to produce sub-registers which are useful for administrative and program monitoring and evaluation. Evaluate the flexibility of the filtering and sorting capability of the patient register function to ensure it meets requirements for local use.

Summary register

Any summary registers that are produced.

Summary registers are useful for program monitoring and reporting on activities. They should be able to be configured and produced automatically from the information that is collected by the EMR. Assess the flexibility and customization features of the summary register.

PMTCT information

PMTCT indicator specific information.

Prevention of mother to child transmission (PMTCT) programs are important and significant in reducing HIV infection. These programs have unique indicators for monitoring their effectiveness. Evaluate the software to ensure that it tracks and can report on the necessary PMTCT indicators that are necessary for local program management as well as project reporting.

Referrals & counseling

Patient referrals for testing, extended care, and counseling.

Because of the complexity of HIV care, it requires a broad, multi-provider approach. However, it is difficult to monitor these complex interactions. The EMR software should capture referrals for testing, counseling, and extended care. Evaluate the software on how well it tracks and reports on these referrals since this is an important function in the success of the program. The software should include features to categorize, sort and filter the reports to show all aspects of interventions.

Notifiable conditions monitoring

Notifiable diseases reporting and tracking.

An important function is reporting of notifiable diseases for epidemiological tracking. The advantage of the EMR is that it can produce these reports from information that is routinely captured during patient encounters. Evaluate the software to ensure that it captures the information that is needed and can produce the appropriate reports. Electronic reporting of this information can improve accuracy and timeliness.

Logistics (drug and equipment inventory and supply)

Drug, supplies, and equipment logistics are complex functions that require their own systems. However, the EMR can provide valuable information to inform the logistics system. Some EMR systems have even been extended to include logistics functions.

Capabilities

Order, inventory, distribution, expiration dates.

The EMR can provide information on actual use of drugs and supplies as a side benefit of routine drug and test ordering. Simple input to the logistics system from this “demand” information can improve logistics. More sophisticated software can track actual ordering, inventory, and distribution of drugs and supplies including expiration dates and lot numbers. These software functions should be evaluated in the context of the overall logistics system.

Integration with patient care

Describe how logistics is integrated with patient care.

In more sophisticated systems, logistics information can be generated by patient care. Demand for drugs and supplies can be tracked by patient care activities. It is important to evaluate the information produced by the EMR system in the context of the logistics system.

Drug Regimen support

A drug regimen is a group of drugs given together. Drug regimen support includes the ability to define and prescribe regimens and also retain the detail of the drugs in the regimen.

The concept of a “drug regimen” is central to ART. Patients are started on a particular drug regimen (typically three drugs) and there may be substitutions and changes of regimen during the course of treatment. In the clinical context, it is important the the software be able to maintain drug regimens and track their use with individual patients. This information also has important uses in logistics as it can produce reports on which regimens (and drugs) are being used. The information can also be used to forecast demand by analyzing factors such as how long new patients are maintained on each regimen before requiring a substitution or change of regimen.

All software:

Reporting

Reporting is essential to patient, facility, and program management. Reporting in the EMR takes advantage of the routine collection of electronic information. Since the information is in electronic format, it can be easily filtered, sorted, and aggregated to produce reports that give insight to the operation of the system. Reporting is an important software function and the software should be carefully evaluated for the type and variety of reports that are produced as well as the flexibility and ease of customization.

Summary reports (time, place status)

Type and flexibility of summary reports for facility.

Summary reports are the basic level of reporting for a facility. They produce information on counts of activities and actors that are very useful for management and program monitoring. The software should be evaluated for the type and variety as well as flexibility and customization of summary reports.

Aggregate Reporting (facility, district, national)

Ability to aggregate data from multiple sites into district and higher level reporting (with sub-totals) .

While individual summary reports are useful for evaluating and managing facilities and individual activities, they are typically aggregated at higher management levels to produce information on broader areas of activity. Electronic system can be designed to improve the speed and accuracy of this reporting by automatically aggregating lower level information. However, this function must be properly designed to transmit and receive electronic information and produce aggregate reports. The software should be carefully evaluated to gauge the ease of producing information for aggregation, transmitting this information to a location for aggregation, and finally for aggregating the information and producing the reports. If all of these steps are done electronically with appropriate protocols, aggregate reporting can be fast and accurate. The software should also be evaluated for its aggregate reporting capabilities. This especially includes the filtering and sorting capabilities as well as the ability to “drill down” into data to explore it in detail.

Monitoring and Evaluation functions (facility, district, national)

Ability to calculate indicators for specific programs. Indicate which programs are supported.

There are many projects that support HIV care and each of these has unique requirements for reporting. Preparing these reports can place a significant burden on personnel. The information in the EMR can be used to produce these reports with much less effort. The software should be carefully evaluated to ensure that it tracks the necessary information required by programs and that the proper reports can be produced automatically.

Epi investigation

Specific reports to look at communicable disease patterns and outbreaks.

Epidemiological investigation is an important function that can be improved through the use of electronic information. The side benefit of collecting routine patient information is that this information is available for analysis of the spread and characteristics of the epidemic. This is important for monitoring and planning activities.

The software should be evaluated to ensure that it records and tracks important epidemiological indicators and that there is a flexible reporting system for analysis of this information.

Research capabilities

Ability to access the database for ad hoc queries. Indicate method of query such as SQL.

The EMR information is a valuable database on the characteristics of the epidemic, the response to treatment, and health system activities. As such it can be an important research tool to provide information on best practices for treatment and management of care activities. Researchers tend to want to perform “ad hoc” queries on data to analyze it as questions come to mind. If the underlying database of the EMR uses as standard query method such as SQL, researchers can make valuable use of the data. Some software also provides useful flexible query tools to improve visualization of the data. Evaluate the software for these features. At a minimum, the database should provide SQL capability.

Reports to funders (including PEPFAR indicators)

Ability to produce specific reports to support funded programs.

Many programs are funded by PEPFAR which has specific reporting requirements. The EMR should be able to produce these reports automatically. Evaluate the software for the ability to collect and aggregate data and produce these essential reports.

Reports to other specific funding programs may also be necessary and the software should be evaluated for the ability to produce any required reports.

Custom reporting

Describe extent to which customization of reports is possible.

Program management and funding reporting often have changing requirements. Evaluate the software on its ability to produce custom reports to meet new requirements. A typical “report generator” allows selection of data fields, aggregation, and indicator calculation through a simple user interface. The new report should then be able to be saved and run again in the future, possibly changing some of the parameters such as dates.

HL7ART data transfer protocol

Support for the WHO HL7ART data exchange protocol.

The WHO is supporting development of a standard for individual patient record transfer. This transfer is useful for moving patient records from one location to another when a patient moves and is important to maintain continuity of care. The other use of this protocol is to send (anonymized) patient records for monitoring of care and research. The protocol uses the HL7 health data and XML data interchange standards.

Evaluate the software to determine whether or not it supports (or plans to support) this HL7ART data

interchange protocol.

Security and Data

Backup tools

Data backup tools that are included other than standard computer backup utilities.

Electronic data is robust because it can be easily copied and transported and can be accessed from multiple locations. However, it is vulnerable to fire, flood, theft, and computer malfunction if it is not copied and stored at multiple locations. Most computer systems have standard tools to make backups of important data that can then be moved to a safe location. Some EMR systems also include tools to make this process easier and more specific to their data. Evaluate the software backup tools to ensure that you can easily make backups of your valuable data and restore it if necessary.

Security

Security of access to the data in the computer and during transport. Indicate if data encryption is supported.

The EMR system will contain valuable information that is personal and may be subject to privacy regulations. The software should have a method of restricting access to the data to authorized persons. There are many protection schemes and degrees of access. Evaluate the software carefully to ensure that it meets your legal and ethical requirements for access control.

Data can be encrypted for storage and transport where it may be vulnerable to unauthorized access. Software should be evaluated to assess its encryption capabilities.

Data transfer

Ability to transport data to another system for analysis. Describe data and process.

The WHO HL7ART data format is one component of data transfer. Software may use this or its own proprietary format for data transfer. The process of data transfer goes beyond the specific format of the data during the transfer and includes procedures for extracting the data from one system, sending it to another, and loading the data into the second system. It should also include the protocol to resolve replication issues where you have multiple copies of the data being used in different locations.

Data validation/quality checking

Type and degree of data validation and quality checking built into the software. Is this done as batch or real time?

Electronic systems have an advantage over paper in that the data can be checked for validity. There are a number of types of checking that can take place to improve the quality of the data. These include range checking, entry against a table of valid entries, completeness of data, and consistency checking against multiple factors (i.e. a pregnant patient must be a female). Data can be checked at the time it is entered which in most cases is preferable to a batch checking process that is performed at some later time when it may be more difficult to correct the errors.

Software data validation is an important function and the software should be evaluated carefully to

assess the type and flexibility of the data checking that is performed. Data checking must be user configurable to accommodate local requirements.

Tools for paper input (i.e. Forms generator)

Are there paper forms that correspond to the data in the computer system for use when a computer is not available. Do forms correspond to data screens? Are paper forms supported for input?

It will be rare to have a complete electronic medical record. The resources required to install computers and associated support infrastructure at every point of care are too great. The software should include the ability to produce paper forms suitable for patient interaction at the point of care. These forms are typically used to provide patient information (summary sheet of history and current status) as well as to collect information for later entry into the computer.

The forms should support a data flow process where the paper form is first printed and contains the necessary information to enable clinician decision making at the point of care. Then the form is used to collect information from the current encounter and finally it is used for data entry into the computer. This form must be capable of being customized easily to ensure that it meets changing requirements. The data input part of the form should be designed to facilitate rapid, clear, data entry. The best way to do this is to have the data input screens correspond closely to the organization of the data on the form.

This is an important function for the software and it should be thoroughly evaluated in the specific clinical context to ensure that it works smoothly and facilitates the patient encounter.

System Information

Software architecture, platform (language, database, OS, server)

Software operating system, program development language, server (if used).

The specific software architecture including operating system, program development language and server are important considerations since they affect cost, deployment, maintenance, and support. This ART Inventory document has a complete discussion of the various architectures to assist in evaluating this information.

Data communication architecture (LAN, WAN/Internet, data import and export)

Types of data communication supported including protocols and modes (wired, wireless, IR, etc).

One of the great advantages of electronic information is that it can be easily transmitted. Software can support various methods of data transmission. Individual implementations will take advantage of various data communication methods. The software should be evaluated to ensure that it supports the intended communication methods. This ART Inventory contains a detailed discussion of data transmission methods to assist in evaluating this information.

Scalable

Can the system scale to large sites, multiple sites, district and national level? How is wide area network communication maintained?

Scaling refers to the ability of software to work on different sizes and configurations of computer

systems. A small clinic may have a single computer. It may grow to a local area network (LAN) with several computers. It may then add another clinic in a nearby location which needs to be connected through a wide area network (WAN). Groups of clinics may become nationwide and may handle thousands of patients. Software that scales well will be able to grow to handle all of these situations.

Software design, architecture and platform determines how well it scales. The issue of scaling is discussed in this ART Inventory in the section on platforms and architecture. This information will help you understand these issues and evaluate software.

Data flow map (paper – recording – transmission – M&E – action)

Describe data flow from collection to entry to communication..

As described above under “Tools for Paper Input”, it is important that the software support an efficient work flow. Most electronic systems will interface with paper at some point, most commonly at the point of care. It is important that the software be designed to support paper point of care forms which are flexible and include information such as patient clinical and demographic information summary and which include a method for recording new information. This new information should then be entered into the computer using screens that are designed for ease of input. Good work flow also includes the generation of alerts and messages based on expert advice systems. Information should be automatically sent to where it can be acted upon. In addition, the information should be used by individual clinicians for patient care and for program monitoring.

Electronic information systems offer many advantages in automated analysis and communication and the computer systems should be designed to take advantage of electronic information. Evaluate the software carefully to assess how well the software automates the process of putting information into action.

User modification at site

Is it possible to customize the software at the user site (non-programmer). Describe fields or lists that are customizable.

Software is by its nature modifiable. Good software allows users to modify some of the options for local use. One attractive feature is the ability to have user definable fields which allow the software to be easily modified to capture information customized to local needs. The reality of information systems is that they must adapt to meet local information needs. ART clinics are not a homogenous environment and individual programs and sites have unique needs.

Evaluate the software to assess its ability to capture local information. How easy is it to customize data fields for local use. One should also look for the ability to structure this locally defined data by designating the data type (text, numeric, date), specify ranges, or pick values from a user defined list. The software should also include the ability to analyze this information and include it in custom reports.

Ease of modification (local or international, and skills required)

What level of effort and skills are required to modify the software.

As noted above, individual countries, regions, and programs will have unique information requirements. Any individual software package cannot meet the needs of all programs. In addition, all software requires maintenance to correct errors in programming and to update it to meet changing

requirements. Fortunately, software can be modified. However, the ease and methods of modification will vary quite a bit from one software package to another. The factors which determine how easily the software can be modified include the language, architecture, data design, software design, platform, availability of source code, local programming resources, and international programming resources.

One of the most important factors is the availability of the source code. If you have access to the source code and have permission to modify it, you can develop local resources to customize and maintain the software. If there are good local resources for software maintenance, they will generally provide better and more efficient service. This gives better control of the software system and data.

Evaluate the software carefully to understand the terms of the license agreement. All software has a license which specifies the terms and conditions for use and access to the source code.

Software distributors offer different licenses and these should be evaluated carefully since it will affect your ability to use and maintain the software. Some distributors may let you view the source code but not make changes, others may let you make some changes but place restrictions on the use of the changed software. If you must rely on an outside software distributor to make changes to the software, they should be carefully evaluated to ensure that they will be responsive to your needs. The license agreement should also specify what will happen if the distributor goes out of business or cannot support the software. In this case, there should be a provision for you to obtain the source code (such as an escrow agreement) so that you can continue to maintain and use the software.

The best access to source code and use license is what is known as “free open source software (FOSS)”. This type of license places the fewest restrictions on your use and modification of the software. FOSS licenses such as the GNU General Public License (GPL) allow you to use, make copies, and modify the software without restriction. The GPL permits the freedom to run the program, for any purpose; the freedom to study how the program works, and modify it; the freedom to redistribute copies; and the freedom to improve the program, and release the improvements to the public.

The important issue here is that since you will be making a large investment in software, equipment, training, and data entry, you must have assurance that you will continue to have use of the software and your data. This requires that you have a reliable software support system and have the option to develop your own support in the event of failure of any external support.

Source code available

Is the source code available for modification? What is the policy on compiling and distributing enhancements?

Source code refers to the high level programming language instructions that are computer compiled into the software program that you run on your computer hardware. In order to make any changes to the program, you must have access to the source code. Access to the source code is the ultimate guarantee that you will be able to fix problems and modify the software to meet your needs.

As discussed above, software is distributed under different licenses, many of which do not give access to the source code. If you do not have access to the source code, you must carefully evaluate the software developer and distributor to ensure that they will be able to continue to support your software installation without interruption.

System documentation available

Is there system documentation available for use by programmers?

Development of software systems is complex and typically includes specifications and software documentation that describe the functional requirements, data design, and specific software design. These documents can be very useful to programmers when they are modifying the software.

The system documentation should be evaluated carefully to ensure that it provides good information for programmers to modify the software.

User interface evaluation

What type of user interface; assess ease of use.

The user interface refers to the visual display and methods of interaction with the software. It is a complex subject and there are accepted principles of good user interface design. A good user interface will be clear, easy to understand, flow logically, and be intuitive. The investment in software, training, and data entry will be significant and a good user interface can make it much easier to enter and access information. It can also improve the ease of training individuals. Most modern computer systems use a “graphical user interface” (GUI) which improves data layout and presentation and permits navigation with a mouse. This is generally considered a superior user interface.

The software user interface should be evaluated carefully to gauge the ease of use and training. Screens should be clear and understandable, navigation from one screen to the next logical screen should be easy. The usability of the computer system should be tested by “naive” users as a gauge of the ease of learning and intuitive factors of the interface.

Web interface

Is a web interface available for use of the software in a WAN?

The Internet is a powerful communications tool for several reasons. It offers both a standard user interface and standard communication method. These are universally understood. The web interface offers information access over a wide area network (WAN). Because of universal support, a lot of software uses a web interface even for local installation. ART systems by their nature will need to be installed in local and wide area networks. Software should be evaluated to assess whether or not it includes a web interface for wide area network access. This may be the same interface as that used for local access. If they are different, the software should be evaluated carefully to assess any differences in the user interfaces and ease of use. Differences could affect training daily use of the software.

Documentation available (language)

Is end user documentation available and in what language(s)?

If the system comes with good end user documentation and training materials, it will be easier to train people and have them using the software efficiently. The software end user documentation should be assessed for completeness and usability. End user documentation should cover all of the functions of the software organized in a logical reference book format. It should be easy to quickly locate clear, complete information on any aspect of the software that an end user might need explained. End user documentation evaluation should also include an assessment of any language needs and translation that may need to be done.

Training material available

Is training material available and what language(s)?

All individuals using the software will need to be trained. If the system comes with good end user documentation and training materials, it will be easier to train people and have them using the software efficiently. Training materials are specific guides used to train individuals to use the software. There may be more than one training guide developed for various users of the system such as data entry, reporting, and system administration. A good training guide presents information clearly in logical sequence organized around specific tasks. Training guides for the software should be evaluated for suitability in your specific environment and for your anticipated classes of software users. Language support and translations should be evaluated for suitability.

Installed base (# users and duration)

What is the installed base of users, numbers of patients, and the duration of time?

Information on the number of installations and patients registered in the system can help in evaluating the maturity of the software as well as its acceptance. While not a guarantee, software that is widely installed and used with large numbers of patients has generally matured to the point where it is reliable, scalable, and addressed data, user interface, and training issues. It also indicates a potential source of support and help with modifications.

Languages supported

What languages are supported?

Language support will be an important consideration. Clearly, the software must support the language used by the majority of people who will be interacting with the software. Often a country may have several languages that must be supported.

There is a software architecture factor that can make it easy for software to support multiple languages. If the software is designed with all of the display text stored in a data table rather than embedded in the source code, it is much easier for the software to support multiple languages. If all of the display text is in a separate table, it is relatively easy to add a new column to the table and translate the text messages into the new language. The software can then support multiple languages just by specifying which language column of the table will be used. If the language requires a special character set, the software should be capable of supporting the “Unicode” standard.

Formal support (type of organization)

Is there a formal organization supporting the software? What is their level of funding and stability?

The software will require continuous maintenance and support to fix problems and stay up to date with required changes. Before investing in software, the supporting organization should be carefully evaluated. The organization that will support the software should be prepared to assure that it will be financially and organizationally stable over the long term. The availability of source code is an important factor to consider in the event that the supporting organization is not able to continue. The supporting organization may be non-profit NGO, for-profit business, or government agency. Each of these types of organizations has strengths and weaknesses but none is immune from failure to support the software. Each should be evaluated carefully.

User community

Is there a community of users available to provide additional support?

A community of existing users can be an important resource for support with installation, training, and maintenance issues. This is an additional source of information that can supplement support from the developer or distributor of the software. Communities of users (particularly for open source software) can be very active and helpful.

Sponsoring organization

What is the sponsoring organization for the software?

Often the software has been developed under the direction of a sponsoring organization which will have an interest in ensuring continuous support for the software. This is another factor to consider when evaluating systems.

Funding source

What is the funding source for the software?

The source of funding for the software is an important factor to consider when evaluating the stability and longevity of the software. An organization that is well funded is more likely to continue support in the face of adversity. Large organizations can be more stable in funding. Governments can have access to stable funding but are also subject to political influences.

Open source software is a special case. Open source software can be developed by large stable organizations but it is often supported by a community of developers and users. Individually, each of these may not be large but the community as a whole can provide much more stability and continuity than any single organization. Of course, with open source, there is always assurance that as a last resort, you will have access to the source code and can provide your own support.

Development team size

What is the development team size and availability for customization?

The number of programmers developing the software is an indication of the support available for customization and maintenance. This should be considered in relation to the number of sites that these developers are supporting. Open source software will often have a large number of developers, each devoted to a particular installation but also contributing to the overall project.

Support team size

What is the support team size and availability?

At least during the initial installation and training, outside support will be required. Often, continuing support will be contracted. The number of people available for this external support should be evaluated in light of the number of installations that the external organization is supporting.

Hardware Requirements

This information is intended to help understand the technical requirements and costs to install a typical

system. The categories of system are generalizations and will change as technology advances. The important factor here is that if the software can run on older or less technically demanding hardware, there is the possibility of reusing existing hardware or purchasing less expensive hardware.

Use this category system: A=current state of the art (2+ GHz processor, 512 MB memory, 20+ GB HD); B=one generation old (1 GHz processor, 128 MB memory, 10+ GB HD); C=two generations old (200 MHz processor, 64 MBmemory, 1 GB HD)

Client hardware requirements (speed, memory)

What are the minimum hardware requirements for client (workstation) computer?

Client workstations will be the most numerous in your system. If the software is capable of running in a web browser or uses a minimal thin client software, then the hardware will cost less since older or less expensive computers can be purchased.

Server hardware requirements

What type of hardware is required for the server?

Servers typically will have more demanding hardware requirements because they must store all of the data plus perform whatever operations the client demands. It is usually best not to try to save money by purchasing lower performance server hardware. There will typically only be one server per site.

Communications requirements (local area and wide area)

LAN (ethernet), WAN (indicate protocol), wireless (WiFi or other).

Most local area networks run using the Internet TCP/IP protocol over Ethernet and this hardware is commonly available and inexpensive. Wide area networks (WAN) also usually run the Internet TCP/IP protocol. However, there are several options for communications including WiFi, WiMax, fixed-line (dial-up modem, DSL, ISDN, T1 in increasing order of speed), and wireless SMS or GPRS. Make sure that the bandwidth offered by the communications method of choice is sufficient for the software requirements. There are significant cost differences among the different communication media and these should be assessed for long term cost.

Software Requirements

The ART application software will typically run on top of an operating system and a database and may also require additional software such as language interpreters or separate packages for reporting. Each of these software packages has a cost to purchase, install, and maintain. Evaluate the cost of all of the software together.

Operating systems for client and server

The most common operating system is Microsoft Windows. The current version is XP which comes in a “Home” and a “Professional” version. The Professional version is significantly more expensive and it may be required by the ART application you choose.

Linux is a popular alternative operating system and is noted to be very reliable. It is commonly used with servers and can also be used as a client operating system. Linux is free open source software.

Database

Most applications run on top of database software. Database software can be very expensive. Oracle and Microsoft SQL Server are two databases that are commonly used and both have significant costs for purchase and maintenance. Some applications can use a “runtime” version of Microsoft's SQL Server which is available at low cost.

There are two popular free open source databases, MySQL and PostgreSQL. Many people feel that the performance and reliability of these databases are better than Microsoft's SQL Server.

You may not have a choice of database software. Some ART applications only run with one particular database so be sure to include the cost of the database in your calculations.

Other software required

Some ART application packages may require the purchase of additional software packages such as reporting software for data analysis. Make sure that you include this in your calculations.

FOSS

The free open source software (FOSS) alternatives that are available for operating systems and databases have surpassed the performance and reliability of the proprietary alternatives so you should strongly consider using these. In addition to low cost (free), they are in most cases more reliable and offer better performance.

Installation/Configuration

Ease of installation

Set-up and configuration

Financial Costs

Cost of Software itself (initial and recurring fees)

Cost of software for initial purchase and any recurring fees.

Often proprietary software will have an initial purchase cost plus an annual maintenance fee. Make sure you include both in your calculations of costs.

Costs of underlying hardware (including back-up systems, maintenance and repair)

These costs can be estimated from the information in the fields above on the categories of systems required for clients and servers. Also include the cost of battery power backup systems, network equipment, wiring, maintenance and repair.

Costs of underlying software (including ongoing license/support fees)

If you are not using free open source software, make sure that you investigate continuing license fees.

Many proprietary databases have annual fees for maintenance.

Cost of modification of software (external contract costs)

The initial cost estimate for the software should include a cost for customizing the software to meet your specific requirements. Most software will require modification to meet local requirements. The initial purchase agreement should specify these modifications and cost.

HR Costs (FTE by skills)

When planning a system, the cost will include many factors beyond the purchase of the software and hardware. Often these are significantly more than the initial “software cost”. In preparing a budget, consider each of these costs for your planned installation.

Customization to local requirements

Documentation (local)

Training (data entry, analysis, supervision, tech support)

Start-up implementation

Ongoing operations (data entry, supervision, analysis, reporting)

Technical support

Maintenance

CDC Requirements

The US CDC has established recommendations for software that promote ease of use, operation, and data communication. These may not be absolute requirements in your situation but they are important factors to consider when making a decision on software.

(1) uses generic web-browsers for data entry and analysis,

The program should use current standard HTML for access over Internet protocols.

The universal web browser offers many advantages since it has a standard graphical user interface and can run on low performance (inexpensive) hardware using standard Internet TCP/IP protocols. Preference should be given to systems that use this interface.

(2) underlying database is an industry-standard SQL solution with ODBC support,

There is an industry standard for database design which is called SQL. There are many tools to support this standard which ensure that you can have full function access to your valuable data. Open Data

Base Connectivity (ODBC) is a standard method of connecting different databases on different operating systems. Preference should be given to software systems that use an SQL database with ODBC connectivity.

(3) authenticates through an LDAP directory,

As part of the security and access setup of your software, it will require a directory of authorized users and their access permissions. A standard method of setting up this directory is the Lightweight Directory Access Protocol (LDAP). The advantage of using LDAP is that it can facilitate common access privileges across multiple applications providing they all use LDAP. This greatly simplifies and the setup and maintenance of directories. Preference should be given to software systems that use a LDAP directory.

(4) security is handled through SSL connections based on X.500 digital certificates,

The X.500 directory services form the core of the LDAP and issues the authentication certificate. This should be done using the web Secure Socket Level (SSL) feature to ensure that there is no compromise of the authentication directory or certificate information. Preference should be given to systems that use this secure method.

(5) uses HL7 for data import and export,

Health Level 7 (HL7) is a standard method of communicating medical information which includes standard tags defining information along with the content. It has been widely adopted in the health field to transfer information between computer systems. There is also an evolving standard for ART using HL7 (HL7ART) which is being organized by the World Health Organization. ART software systems must be able to send and receive information with other systems. HL7 is the method of preference and the ART software you select should offer HL7 support.

(6) uses ebXML for Internet-based data brokering.

Electronic Business using eXtensible Markup Language (ebXML) is a family of XML based standards sponsored by OASIS and UN/CEFACT whose mission is to provide an open, XML-based infrastructure that enables the global use of electronic business information in an interoperable, secure and consistent manner by all trading partners. This level of communication goes beyond HL7 to include generalized automatic messages. Typical uses in the ART context may be laboratory test ordering and results reporting. It supports advanced communications among information systems.