AccessSTAT™
ASPYRA, LLC®

The ASPYRA Approach to Healthcare Analytics in Diagnostic Imaging

Data Collection without Interfaces

Today's Needs

Hospitals and other health institutions continue to make massive investments in connecting systems, modalities and data stores through the implementation of HL7 and through standardization with protocols like DICOM.

Today, there is a growing demand for access to the core data and real-time analytical capacity. Most applications have some reporting capacity built-in, and most have the ability to develop further reports over time. As a rule, these reports are retrospective – focusing on events in the rear-view mirror rather than viewing the information through the windshield.

Retrospective reporting is important for a wide range of uses, including audits. Helpful to some extent in making decisions about the future, they cannot assist in framing responses to events and developments as they happen. The ability to report in real time is further constrained by the ability of production systems to accommodate immediate requests for data without impact on essential production functions.

Taking advantage of investments already made

For institutions with unlimited funds, the development of data warehouses and the associated intelligence functionality presents the best long-term solution to providing managers with access to data and analysis. Both implementation and maintenance costs are significant, while licensing rules act as a deterrent to extending access to the data to a wide range of line managers throughout the system.

The ASPYRA solution was designed to use investments already sunk in the connectivity infrastructure. The initial requirements for the application included (a) the avoidance of interface design and build; (b) near real-time data availability; (c) no impact on networks or production systems; (d) easy-to-use user interfaces; and (e) user control of filtering and drill-down capacity.

White Papers

This paper is one of a series designed to allow for an open discussion of functionality in ASPYRA Healthcare products. The extent of 'fit' with healthcare analytics requirements along with the potential contribution to the long-term perfection of analytics is explored.

In its current form, the application is delivered as a hardware or VMware appliance. Its position in the network infrastructure uses a mirrored port on a switch (or switches) that feed information to a PACS. The system detects connections between devices on the network and the PACS, travelling in both directions. DICOM, HL7, network and XML messages are captured and submitted to the parsing process described below.

Because of the mirrored port design network impacts are negligible while no activity touches the key production systems needed to perform the diagnostic imaging functions.

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Parsing data in real time

All detected connections are pulled into memory on the ASPYRA system and parsed in real time. DICOM headers are parsed and stored, while the imaging payload is dropped. Similarly, HL7 messages are parsed and stored in a secure and encrypted database and relevant network flow information is parsed and stored also. Finally, where needed to extract information, XML messages destined to specific ports are parsed and stored.

On-going testing ensures 99.999% accuracy in the parsing process while AES 256 encryption secures the data.

A number of customized dissector tools operate within the application to perform the parsing task. On-going testing is carried out to ensure that accuracy of 99.999% is achieved in the parsing process. Technical discussion papers on the test process are available from ASPYRA.

All parsed results are stored in an encrypted (AES 256) and digitally signed database and can be readily archived to hospital storage systems to protect the raw data. A further process moves the data into a separate reporting database that is accessed by users through a web interface. Users never touch the original raw data.

As the raw data are parsed into a separate database resident on the system, approximately one year's data (the most recent 12 months) are retained and instantly available for reporting and analysis. Older data can always be reparsed from the secure raw data store as needed.

Design of user-friendly tools

The core objective driving the design of the ASPYRA system was to make the analytical tools useful and meaningful to managers who have not had training in sophisticated analytical techniques. Managers need access to information in real time. This demands a user interface that is simplified as much as possible without disguising the powerful underlying data that are available.

The system offers managers analytics without the need to request information from IT or reporting departments, and without the drafting of complex data extracts. No reports are pre-developed, but all viewed reports can be readily saved by a manager for future use and can be set to be sent to colleagues as needed.

The application of filters is seamless and the effect of those filters is obvious. Everything can be printed and everything can be saved in .pdf or HTML form for distribution to members of the team. Some of the most effective users of the system sign on during staff meetings and project the results for the assembled group. Questions asked by the group lead to the application of new filters and immediate response from the system.

The design of the system opens the analytical world – open access to all who need information and understanding and provide swift easy answers to the questions that matter to managers.

Imaging analytics

The package presents information in four quadrants ranging from some immediate dashboard-like displays about basic data, a fully interactive and controllable graphics section that provides a visualization of the data being requested, a tabular presentation of the data that are active as a result of filtering and a quadrant that allows for the setting of filters and functions that control the selection of data, the storage of reports that will be run frequently, search functions and so on.

Tabs on the graphical display allow for shifts in time-scales, from days to minutes and a further set of tabs controls whether “Studies”, “Volumes” or “Throughput” are to be displayed to the data then being viewed. The actual time periods, down to spans as short as parts of an hour are set in the filtering quadrant.

All tabs displayed in the data table section are filterable and all are linked, allowing for extremely granular filtering and drilling down to the needed data. At this level, three master tabs, Image, Practice and Procedure Management presents a significant array of further tabs that provide remarkable detail. Any category, on any tab can be set as a filter, and multiple categories can be ‘stacked up’ to act as a single filter.

Any change in filter automatically changes the graphical visualization to provide the visual cues needed to understand the impact of the filtering and drilling process.

Managing workflow in the DI environment

Data collected from both DICOM and HL7 are used to present expired time associated with nine major steps in the radiology workflow. Tracking expired times from booking to distribution to the referring physician the system provides managers with a clear view of what is happening with the workflow.

The clear view then becomes a powerful management tool by providing for user-set benchmarks that are used to drive productivity and efficiency throughout the department. Again, the use of the application in staff meetings can be enormously useful in managing a continuous improvement process in radiology.

Filters are readily available as is the ability to drill down to a single patient, technologist, radiologist or accession number. The workflow section of the application uses both DICOM and HL7 data. Usually, subsequent to deployment some mapping of HL7 data will be needed, using the ASPYRA toolset built for that purpose.

Opening the door for advanced analytics

The ASPYRA approach uses a number of techniques to open the application for use by sophisticated analysts seeking to do significant research with the data the application has collected, parsed and stored.

Initially, the likely users of the base application were looking for a tool designed to produce data, reports and analytics that are easy to use and access. The typical user is focused on producing information and intelligence immediately useful for line and operational managers in the healthcare environment. To assist this objective, highly intuitive interfaces that minimize training requirements and cost burdens were created.

More advanced users, as described below, need to be able to perform analysis that it prescriptive and predictive. The construction of analytical models useful in population health management, for example, requires a different level of statistical skill and a more intensive commitment to developing explanations and predictions based in statistical analysis.

Where the out of the box application allows for .csv extraction of data and anonymization if needed for advanced analytical work, the addition of functionality described below enables full advanced analytics capacity, using tools readily available to researchers.

An ODBC/API is created to allow for calls against the main system database. These calls are limited to High Water Mark (new data since last extract) or Date Range Calls. This limitation is imposed to ensure there will be no impact on the production system from these calls.

The Advanced Analytics Module contains a PostgreSQL database, and includes automated nightly backups of the data that have been extracted to it. The module also includes optional functionality to maintain a second copy of the real-time database supplied by the parser, effectively the ETL process. The module also includes a version of the security and user controls resident in the main application.

ODBC functionality allows users to have direct access to the module database using common open-source statistical applications such as R. R is an open source analytical package used by more than 2 million researchers world-wide, and is extensively supported by the user community.

Effectively, the Advanced Analytics Module is designed to provide a tool-set for advanced analytics producers and consumers, taking the application beyond the methods and approaches needed for line managers in a health care environment. In combination, the core system along with the Advanced Analytics Module provide a powerful analytical tool while making data immediately available and ready for a data warehouse environment when that is constructed.

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