



TDS Connection

THE LATEST FOR TDS PARTNERS | September 2022

FEATURED STORY

Matching Clinical Trial Subjects with Researchers in Real Time

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Complex Event Processing (CEP) is a real-time alerting system developed by Research IT and used by several departments within Stanford Medicine. Primarily used to prescreen patients for enrollment in clinical trials, CEP has proven valuable in solving the challenge of researchers being able to contact subjects who are very likely to be eligible for a clinical trial enrollment in a timely manner.

Prior to CEP, researchers would have to inform the registration desk or clinical staff on duty to call researchers whenever a patient meeting certain criteria was on site. By the time researchers got around to contacting patients, in all likelihood the patient would have left the hospital premises. “Before alerts were developed, one of the team members needed to be ‘on call’ nights and weekends and checking our participant log every few hours to make sure no one was missed,” notes a Maternal Fetal Medicine department researcher.

Although the primary use case for the CEP engine has been clinical trials, it can be used for anything that requires an action in real time whenever a patient meets interesting clinical criteria, albeit with minor modifications to the engine. An example of this is a recent addition of the REDCap application programming interface (API) hook developed to support a range of REDCap integrations.

CEP is built on [Esper](#) event processing software and is configured to continually read live Health Level Seven (HL7) feeds. Our CEP engine currently reads ADT (admit, discharge, transfer), Order, SIU (Scheduling Information Unsolicited), and Result feeds from both adult and children's hospitals.

For an alert to trigger, a clinical criterion must be met. For example, one of the earliest alerts was used to screen patients for a clinical trial in the use of prophylactic antibiotics in the management of dog bites. Criteria for this alert consisted of patients aged 18 and over visiting the emergency department with an animal/dog bite. This alert would be triggered by the engine whenever an ADT message is received with patients whose date of birth in the PID (patient identifier) segment is 18 or more years ago, with Emergency as the department in PV1 (patient visit) segment and DG1 (diagnosis) segment containing dog/animal and bite keywords.

CEP features and customization

CEP's strength lies in its ability to support rapid development and customization of alerts to meet various criteria that a screening protocol might need, such as the following:

- Ability to send patient details, matching conditions that triggered the alert, patient location, and name of the attending physician in a secure email to researchers.
- Ability to send a text to researchers' mobile devices/pagers indicating an event of interest has occurred and that they should check their email for more details.
- Criteria definition (in a SQL-like format) with email/phone number setup in a configuration file. Most simple alerts do not need code changes.
- Alerts can work in conjunction with REDCap. For example, the alert for Maternal Fetal Medicine was used for sample collection (cord blood, maternal blood, and/or placental tissue) from a list of patients. The list was maintained in REDCap. Every time a condition was met, the CEP engine would make a REDCap API call to check if that patient was in their list before sending out the alert. This feature is particularly useful if researchers want to be alerted on a predetermined cohort of patients and not every patient that matches the criteria.
- Ability to send alerts to different phones/emails depending on the hour of the day and/or day of the week. This is useful when researchers have a pager that is rotated among team members.
- The engine keeps track of the alerts in a relational database, thereby avoiding duplicate alerts for the same event.
- Alerts can be easily switched on and off. This is particularly useful for seasonal alerts such as an influenza alert, which only runs from January through May.
- Alerts do not always have to be from just one HL7 feed; they can be generated from multiple message types that may or may not happen simultaneously. For example, an alert triggers when a patient visits the Emergency Department (ADT message), has two orders (ORDER message) placed — one for international normalized ratios (INR) lab panel and the other for CT scan of the head — and gets a value of 1.1 or more for INR in the lab result (RESULT message). These three events can be limited to occur in a certain time frame of each other, which is eight hours in this case.

- The CEP engine keeps track of the last message that was processed in each of the feeds. In case of a scheduled downtime or a system crash it can be restarted without having to start processing HL7 messages from the beginning of the day. This avoids researchers getting multiple alerts and avoiding delays in receiving alerts.
- The alerting engine is customizable to not only send emails and pages but can very easily perform other tasks such as running custom scripts. For example, it was used by the Alliance Sleep Questionnaire to transmit a summary report of a survey to Epic whenever a patient meeting certain criteria checked in at the front desk of a sleep clinic. The summary reports are inserted into patient medical records as Word documents. This allowed sleep clinicians to review the latest survey with the patient during their appointment.
- The CEP engine is well integrated with REDCap. REDCap projects can now be populated with patient details depending on alerting criteria.
- The CEP engine enforces patient and encounter level filters such as the High-Profile Patient filter, occupational health filter, and insurance plan filter that are required by Hospital compliance.