A collaboratively developed EHR-agnostic standards-based clinical decision support solution for gonorrhea treatment, HIV screening and PrEP prescriptions

Knowledge base development

Logic Development

Based on collaborative input from the project team, logic was drafted in spreadsheets for individual scenarios, describing clinical settings, patient data used, and triggering actions, with intended outcomes and explanations. Mockups of alert dialogs were made in presentation slides to demonstrate the expected design of what would be displayed to a clinician user, and logic behind various scenarios. Additional feedback was provided asynchronously via email with clinical partners.

Rule logic was written in HL7 Clinical Quality Language (CQL), an ONC-designated standard for clinical quality metrics and supported for use in CDS artifacts in FHIR resources (e.g., Library, PlanDefinition). CQL libraries were written using the VS Code program, with a CQL plugin[1] that allowed for syntax correction and basic testing.

Value Set Creation

Multiple value sets of standard codes needed to be created for the data retrieval expressions, for patient history of medications, allergies, and test results. The final list of the value sets needed evolved over the course of the project with multiple changes in design and scope. We first checked the National Library of Medicine Value Set Authority Center (VSAC) for the existence of published value sets that could be reused in this project. Ultimately only one published value set of HIV diagnosis codes was able to be reused, due to the need for specificity in medication routes, body sites, and laboratory tests as used in rule logic.

Medication value sets (of RxNorm codes) were needed for the following:

[1] https://marketplace.visualstudio.com/items?itemName=cqframework.cql

- Ceftriaxone: for detecting orders being signed for presumptive treatment, and for detecting history of adequate treatment in laboratory-confirmed scenarios
- Azithromycin, injectable gentamicin, and cefixime: each as separate valuesets: for detecting history of adequate gonorrhea treatment
- Lidocaine, injectable forms: for detecting whether or not a suggestion for ceftriaxone should also include lidocaine. It was noted that in one ED setting, intramuscular ceftriaxone was usually ordered as a combination with lidocaine to reduce the pain of the injection. The type of suggestion offered was designed to reflect the original order, whether a formulation with or without lidocaine. The medication valueset was necessary to implement this logic.
- Cabotegravir injectables and oral emtricitabine: for the HIV PrEP scenario, as these medications are used for PrEP. Patients with a history of these medications, in specific time frames depending on the agent, were excluded from receiving the recommendation to provide information about PrEP

Detection of beta-lactam allergy required using RxNorm and SNOMED medication codes, as allergies could be captured as a reaction to a specific product or ingredient (predominantly RxNorm codes) or to a drug class (predominantly SNOMED codes). One composite valueset was constructed including both.

Observation and laboratory value sets (of LOINC codes) were needed for the following:

- Body weight: for determining adequate dosing for both presumptive treatment and laboratory-confirmed gonorrhea. Initially there appeared to be a value set that could be repurposed, but it was modified over the course of the project to include measurement times that did not align with the project needs. Therefore, a custom-made value set focused on the body weight measurements used at the clinical sites accessible in EDs was created.
- Gonorrhea laboratory tests: for detecting positive results for the laboratory-confirmed scenario. While there are many codes for gonorrhea-containing laboratory tests, initial exploration revealed that no body-site-specific codes were used in production. The final created valueset was only a small number of codes for gonorrhea tests that did not specify a site of specimen collection

The body site of laboratory tests required creation of specimen value sets (SNOMED “specimen” codes). One was created of pharyngeal specimens, and another of all anorectal and urogenital specimen codes in SNOMED.

Diagnosis codes of HIV were needed for exclusion of patients from HIV PrEP recommendations; an adequate published valueset of ICD-10 and SNOMED codes was used for this purpose.

Medication valuesets were created initially by an internal tool and stored on VSAC. All other valuesets were created within VSAC. SNOMED valuesets were created as intensional (rule-based) ones using the hierarchy of parent-child relationships. LOINC value sets were created as extensional (enumerated lists), with search and selection of individual codes. All were loaded as FHIR resources in the CDS server and published through VSAC by the associated CDC subdivision (STI or HIV).