
**The Socratic Grid Project - www.socraticgrid.org**

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## Overview

Socratic Grid is an emerging Clinical Decision Support (CDS) platform for health care environments. It seeks to provide the knowledge management, business intelligence and predictive analytic technologies required for advanced cognitive and workflow optimization. An Event Driven Architecture (EDA), combined with a Service Oriented Architecture (SOA), is used to deploy and manage these capabilities. The EDA handles the temporal aspects required for effective Clinical Decision Support, including initiating appropriate analytic processing in response to real-time events. Triggers can be messages, for example, HL7 transaction sets used to communicate laboratory results or patient monitor waveforms that require Complex Event Processing to be handled effectively. The initiated workflows are then managed using SOA components; each service ensuring that core business logic is well abstracted, reusable, and encapsulated behind standards-based inter-faces. A workflow engine provides the advanced process orchestration and state management critical for executing complex clinical guidelines and treatment plans.

A Production Rule engine (Drools) is utilized to a) capture and encode clinical domain expertise, b) ensure process validity with respect to declarative constraints, and c) provide flexible control over application and middle tier behavior. A design principle unique to our approach is that rule and workflow processing is done in a patient-specific context, each session being dynamically instanced and provisioned with select knowledge bases and individualized preferences. This design, while resource intensive ensures personalized, high-performance rule evaluations. However, not all clinical decisions are best approached with predicate logic; some require alternative inference techniques. To expand the analytic capabilities available, we have implemented a Predictive Model Markup Language (PMML) infrastructure, the de facto standard used to represent predictive models, so that risk-assessment and diagnostic models can be plugged into the Clinical Decision Support architecture.

The Socratic Grid mission is to change behavior and improve health care outcomes for patients. This is a data-driven objective, and consequently, the Socratic Grid infrastructure is designed to request and persist clinical data from distributed government and civilian networks using the Federal Health Architecture (FHA) Nationwide Health Information Network (NwHIN) architecture. It aggregates this distributed clinical information with local data, such as site-specific research databases or legacy electronic medical records (EMR), to create a virtual warehouse ideally suited for developing individual

and population-based action plans. The Socratic Grid Architecture then manages the data structure and semantics required for advanced clinical decision support, resource optimization, and predictive analyses, exposing these capabilities in the appropriate tools and user applications.

## Mission

The mission of Socratic Grid is to democratize CDS through the collaborative development of open-source, standards-based CDS tools and resources that can be integrated with diverse health information systems to improve health and health care at scale.

## Scope and Expected Contributions

Socratic Grid includes several prototypical applications designed to facilitate knowledge management and usability in the clinical environment. It encompasses the collaborative development of tools and resources to support an open-source, service-oriented, standards-based approach to CDS. Within this overall scope, expected contributions include the following applications.

- Patient Portal: Patient Portal is a patient-focused application that improves collaboration between patients and health care professionals by providing patients with their personal medical records, a patient inbox for receiving communications, articles, and documents that educate a patient on health concerns, and other health care management tools. Patient Portal enables patients to participate actively in their treatment. It allows them to review their medical data, access education material appropriate for the layperson, and manage their healthcare much as they now manage their business affairs through other online resources. It provides patients with tools to exchange emails with their providers, receive recommendations and alerts related to their care, and complete the tasks requested by their health care provider team. As informed partners collaborating dynamically with their health care providers, patients have the opportunity to engage fully in a lifelong educational program that empowers them to control their own health care actively.

- Provider Portal: Provider Portal similarly is focused on the professional, who needs less education. Provider Portal tools are more sophisticated, designed to facilitate the health care provider's decision-making process. Provider Portal provides clinical analytics and diagnosis tools, in addition to standard EMR functionality. Through the Provider Portal web-based user interface, health care professionals manage their patients' care and collaborate with patients in deciding the best course of treatment. Provider Portal provides advanced, state-of-the-art tools that support health care professionals in risk assessment, disease probability analysis and diagnosis, and facilitates the creation of rules and workflows used by the rule engine for clinical decision support. This version of the product focuses on improving health care outcomes for patients diagnosed with PTSD. Provider Portal provides clinical analytics and predictive models to support the clinician's decision-making process in managing risk, diagnosing, and treating patients. Socratic Grid, via its rule engines, decides what to do, its dynamic and iterative

diagnostic capabilities automate the needed tasks, and its notification capabilities communicate with patients and providers to result in the most efficient and timely use of resources.

- Universal Inbox: The Socratic Grid portals use the Universal Inbox as their mail box. The Universal Inbox is similar to other well-known email clients, but is able to manage more than just email. In the current version of Socratic Grid, Inbox messages include CDS alerts, with or without associated tasks, or NwHIN documents from other health care organizations. In Provider Portal, two inboxes are available to a provider: a Desktop Inbox for messages sent directly to or from the provider, and an EMR inbox, for messages sent to or from a selected patient to health care providers contributing to his or her care. In Patient Portal, only one mailbox is supported, the Messages Inbox; it provides a patient with a dedicated client for communicating only with their health care providers.
- Clinical Analytics Drawer: The Socratic Grid Clinical Analytics Drawer displays information regarding a patient's relative risk for developing one or more diseases. This analysis is done automatically using patient information that Socratic Grid retrieves from the EMR system in the background. For example, when the patient checks into a clinic for a visit with his or her provider, the system initiates an analysis of the clinical record, feeding relevant information to the predictive models that assess risk for a variety of common medical conditions. By the time the provider sees the patient, the results of that analysis are available within Provider Portal. The Clinical Analytics Drawer displays a patient's relative risks to the provider in a way that is sensitive to the provider's workflow.

- Diagnostic Guide: A high relative risk score in the Clinical Analytics Drawer should not be misinterpreted as diagnostic. For example, a patient with even a 90% probability of developing Post-traumatic Stress Disorder may not actually have the disease. To facilitate an appropriate workup for a condition in question, a provider can access the Diagnostic Guide functionality. When launched, the Diagnostic Guide replaces the center canvas area of the portal with a graphical depiction of the steps and choices available to a provider while making decisions regarding a diagnostic workup. In the PTSD use case, the tool initially displays the Disease Certainty Score (current probability of disease), the calculated confidence interval, and a select list of diagnostic tests and interventions that might be appropriate during the workup. For example, options may include performing a psychometric assessment, obtaining relevant imaging studies, completing survey questionnaires, or ordering laboratory tests. For each of these, the Diagnostic Guide calculates a utility score that reflects the model's estimation of the contribution to diagnosis that a particular option provides. A utility score is a reflection of the benefit an intervention might have for achieving a particular clinical goal. When a provider selects one of the options presented, the system displays a summary describing the intervention, its potential relevance for the workup, and whether the choice is available at the local facility, the local community, or both. After reviewing this information, the provider can accept the choice and trigger the subsequent workflow.

- Resource Capacity Simulator: The Resource Capacity Simulator provides tools for the health care administrator to optimize the allocation of resources for treatment. It helps health care administrators to predict the number of new cases of a particular disease to expect when a specified population deploys. The application determines the maximum number of patients that the current health care facility resources can accommodate, based on definitions contained in a specified constraint set. The Resource Capacity Simulator adjusts schedule, resources, and other variables to provide the best recommendation for resource allocation, including staff, hospital beds, and equipment. It determines additional resources required to care for new patients after available resources have been optimized. The current version of the product focuses on optimizing resources in the treatment of post-traumatic stress disorder (PTSD), but countless other conditions can be similarly managed.

- CDS Workbench: The CDS Workbench provides the clinical domain expert with a graphical tool to author domain knowledge (rules, guidelines, and other logic) using an intuitive application. The Workbench simplifies the creation of complex content by representing various clinical tests, activities, and procedures as objects in a drag-and- drop graphical editing environment. When authors are finished and wish to deploy, the workbench compiles their work for storage and later retrieval by the run-time system. Data elements exposed to authors for building rules are semantically constrained using the appropriate vocabularies stored in the Knowledge Module Repository (KMR). When deployed within the run-time environment, the system can leverage this semantic metadata to ensure that logical operations resolve with the highest degree of precision possible.

As needed, individual sub-projects will be chartered to further develop various aspects of the prototypes contributed above.

## IP Issues

Socratic Grid uses the open-source Apache 2.0 License (http://www.apache.org/licenses/LICENSE-2.0.html).