

Introduction

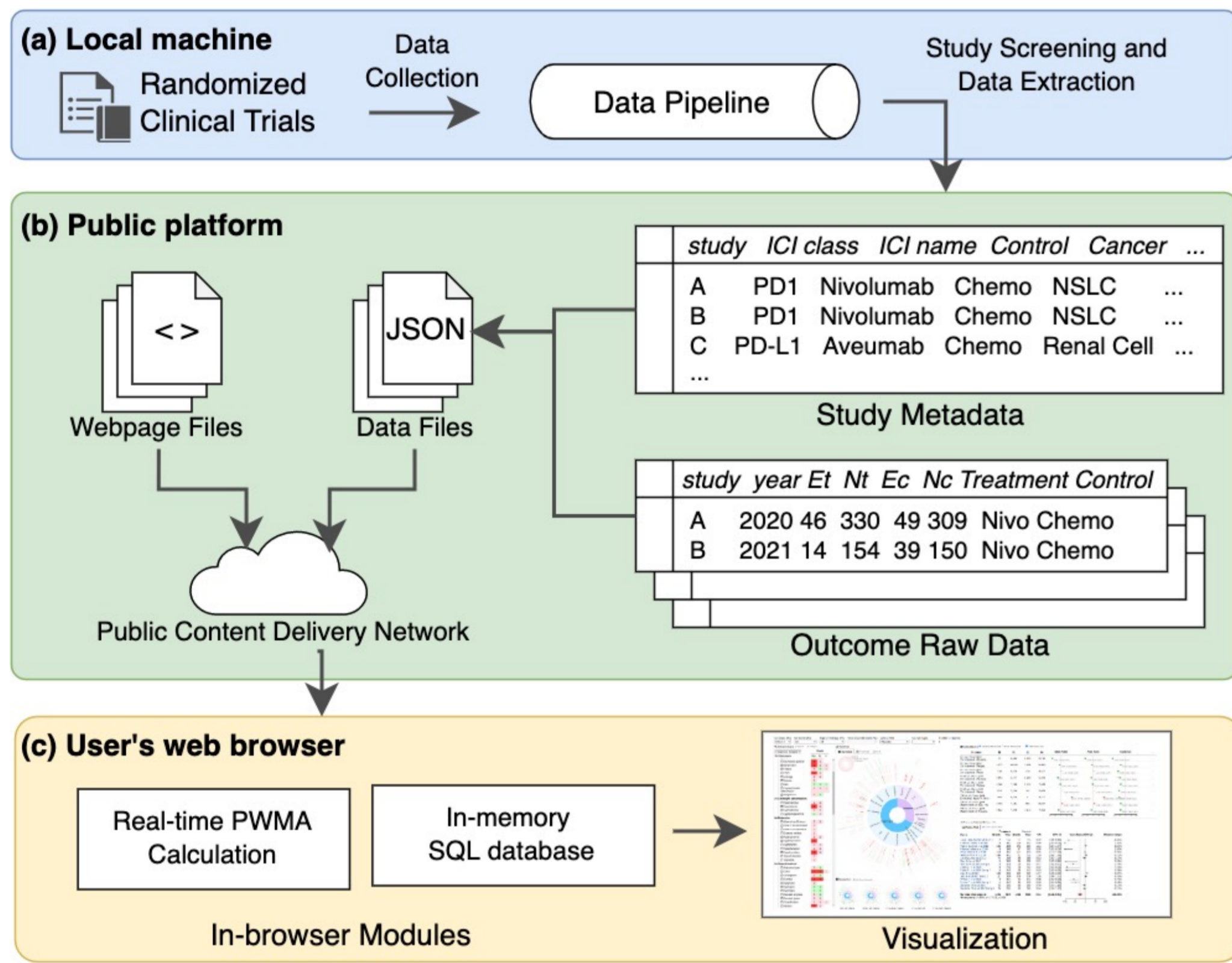
Cancer is a significant health problem. A comprehensive summary of the treatment plan's benefit and harm outcomes will not only help researchers improve drug development but also help clinicians make clinical decisions.

To summarize the findings and synthesize evidence, pairwise meta-analyses (PWMA) are used to get precise estimates of treatment effects. However, presenting the PWMA results from many trials and across many patient-important outcomes can be challenging.

To address the challenges, we developed a web-based visual analytics system based on a customized JavaScript PWMA module to facilitate real-time exploration of massive PWMA results. Clinicians and researchers can analyze the PWMA results data for guideline development and clinical decision-making.

System Architecture

We applied a serverless architecture to design our system, which consists of three major components: a data pipeline that runs on a local machine, a public platform that hosts webpage and data files, and a visualization frontend that runs in the user's web browser:

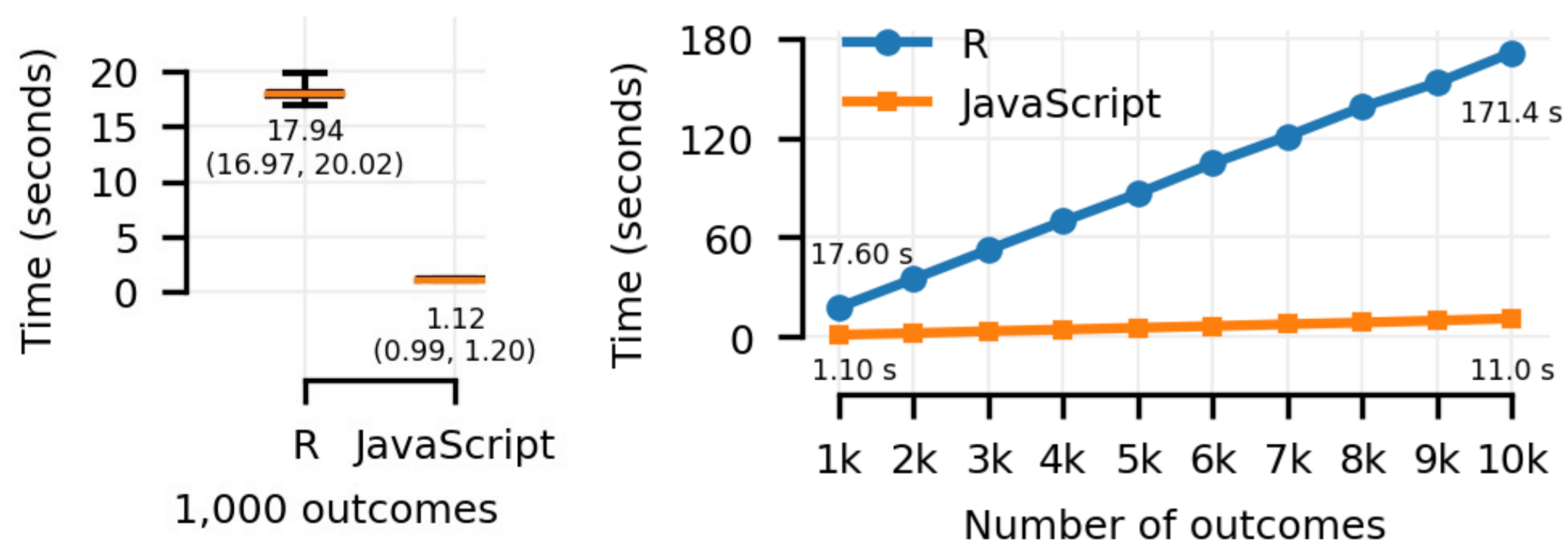


Real-time PWMA

To facilitate real-time exploration and reduce the time spent on computation and transmission, we developed **Meta.js**, a JavaScript PWMA module based on Math.js and implemented the commonly used PWMA indicators such as the DerSimonian-Laird estimator, the Cochran's Q, and the Higgins & Thompson's I² statistic.

The source code and online demo of Meta.js are available at: <https://github.com/OHNLPMeta.js>.

To evaluate the performance, we conducted two experiments: 1) Fixed effects of PWMA on randomly selected 1,000 outcomes; 2) Fixed effects of PWMA of a different number of outcomes. The results are as follows:



Test machine: Intel Core i5-10400 and 16G RAM, running Ubuntu 20.04 LTS. Google Chrome is Version 99.0.4844.51 (Official 64-bit). The R environment is 3.6.3 with meta library 4.18-0 and RStudio 1.4.1106. In both R and JavaScript versions, the test dataset is pre-loaded to reduce I/O cost.

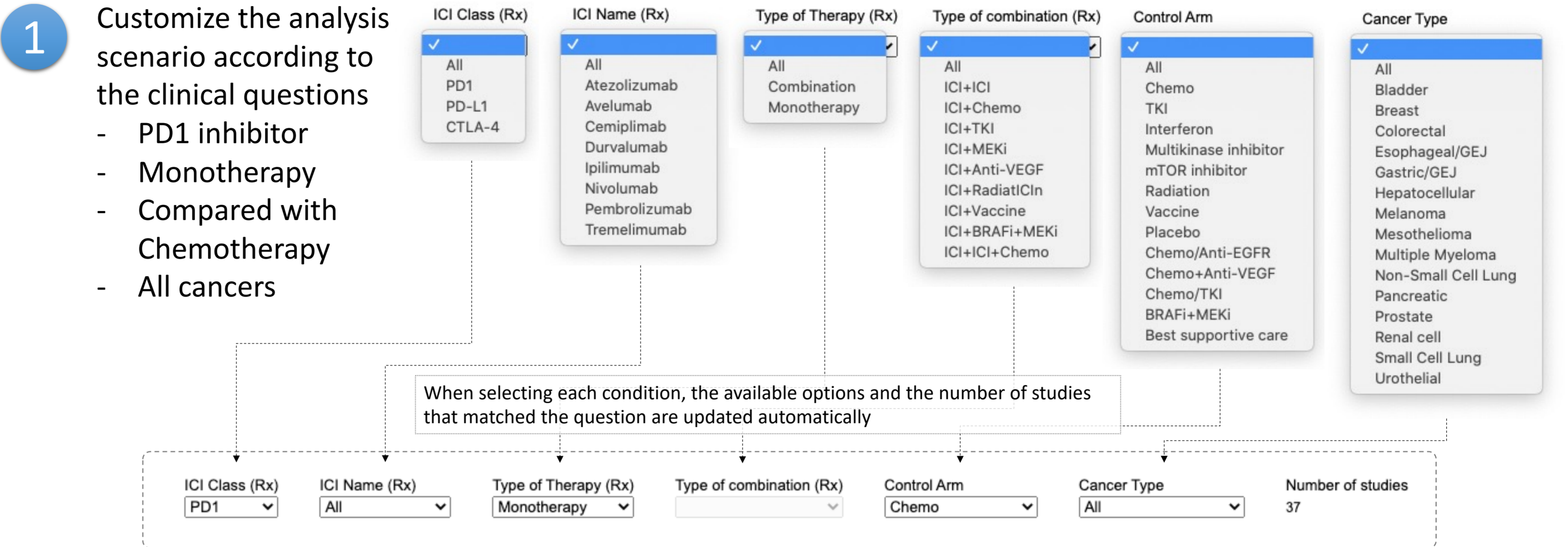
The results show significant performance improvements, which can enable users to check multiple effects (e.g., odds ratio, risk ratio, etc.) at the same time and compare the results between different cohorts, clinical scenarios, and treatment plans.

Future Work

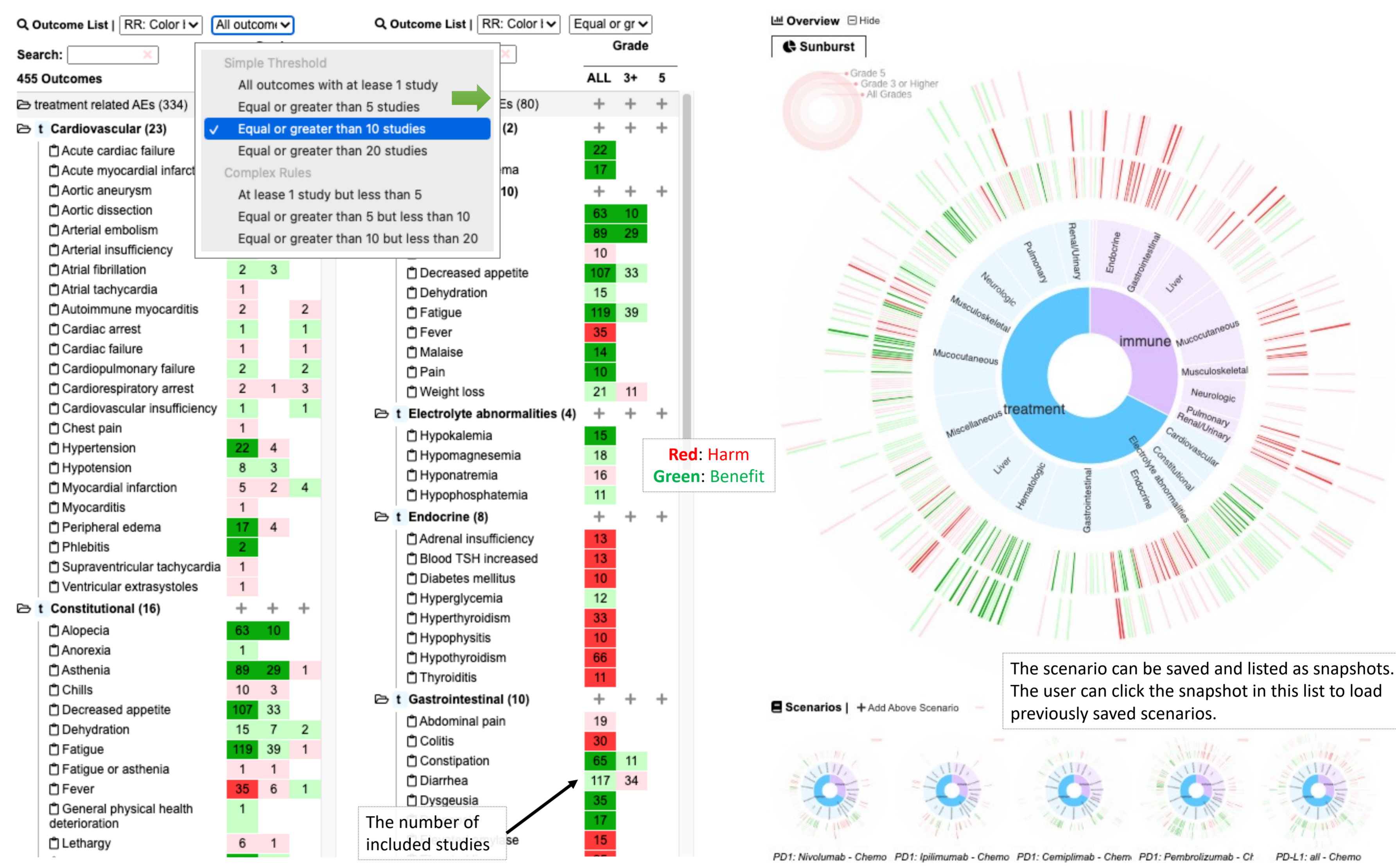
As the next step, we will keep developing the PWMA module and the visual design for further exploration of large-scale PWMA results and apply the results in shared decision-making.

Visualization and Interactivity

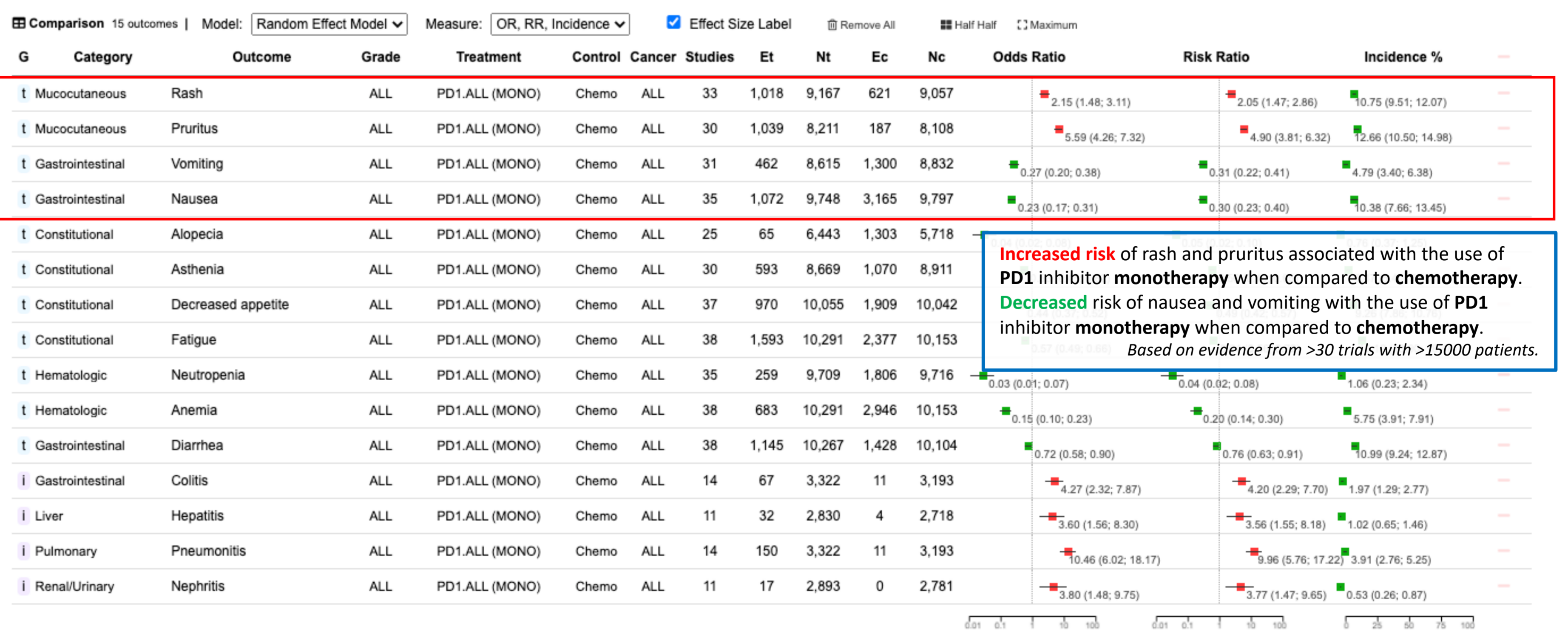
Clinical Question: What is the risk of **all-grade rash, pruritus, nausea, and vomiting** with **PD1 inhibitor monotherapy** as compared to **chemotherapy** in patients with **cancer (type not specified)**?



Step 2: Check the filtered available outcomes. The user can further specify the number to screen those outcomes with more studies. The PWMA of these outcomes is processed in real-time and the results are visualized.



Step 3: By selecting the outcome in the outcome list or the overview, the user can compare those selected outcomes in the comparison view and check the visualized PWMA results to address the clinical question.



Step 4: For each outcome, the user can check the detailed analysis information from each study (i.e., forest plot) to validate the certainty of evidence and track the original source of each study.

