

Harnessing Quarto's Multi-Language Framework

Integrating Analytical Rigor with Interactive Visualization
for Enhanced Clinical Insights

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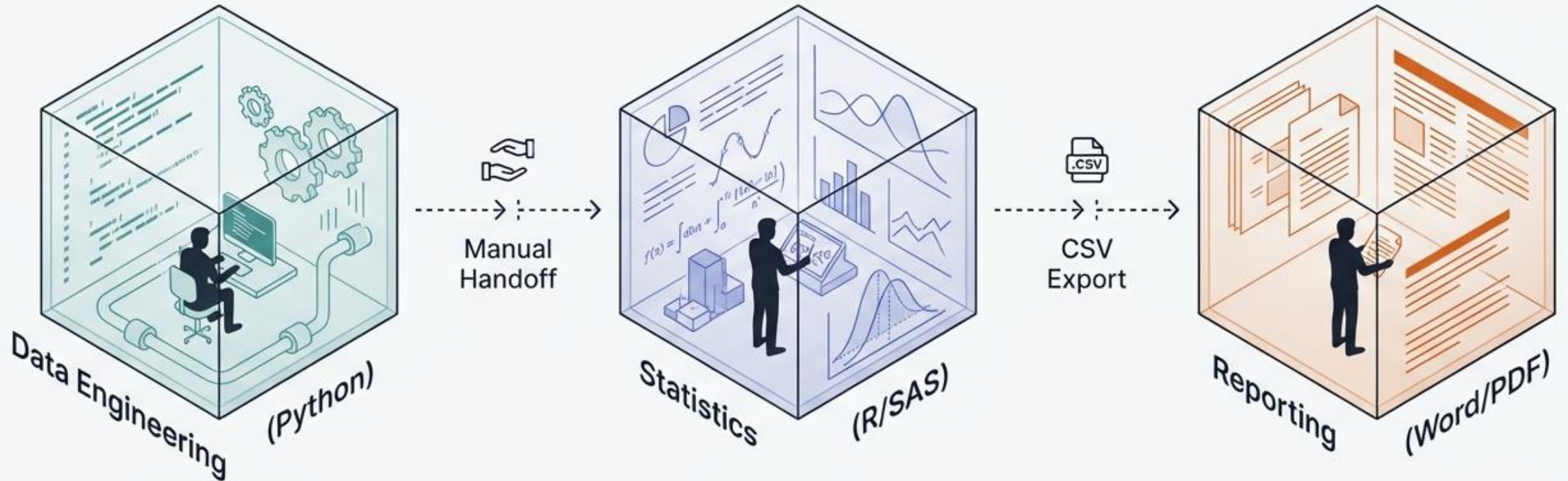
Disclaimer

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- This material is based on publicly available information regarding open-source tools. All code samples and datasets used herein are mock representations generated for demonstration; they should not be considered proprietary, confidential, or indicative of actual clinical results.
- While this presentation highlights reproducibility and analytical rigor, the provided code chunks are for conceptual illustration and should be independently validated before application in production environments.

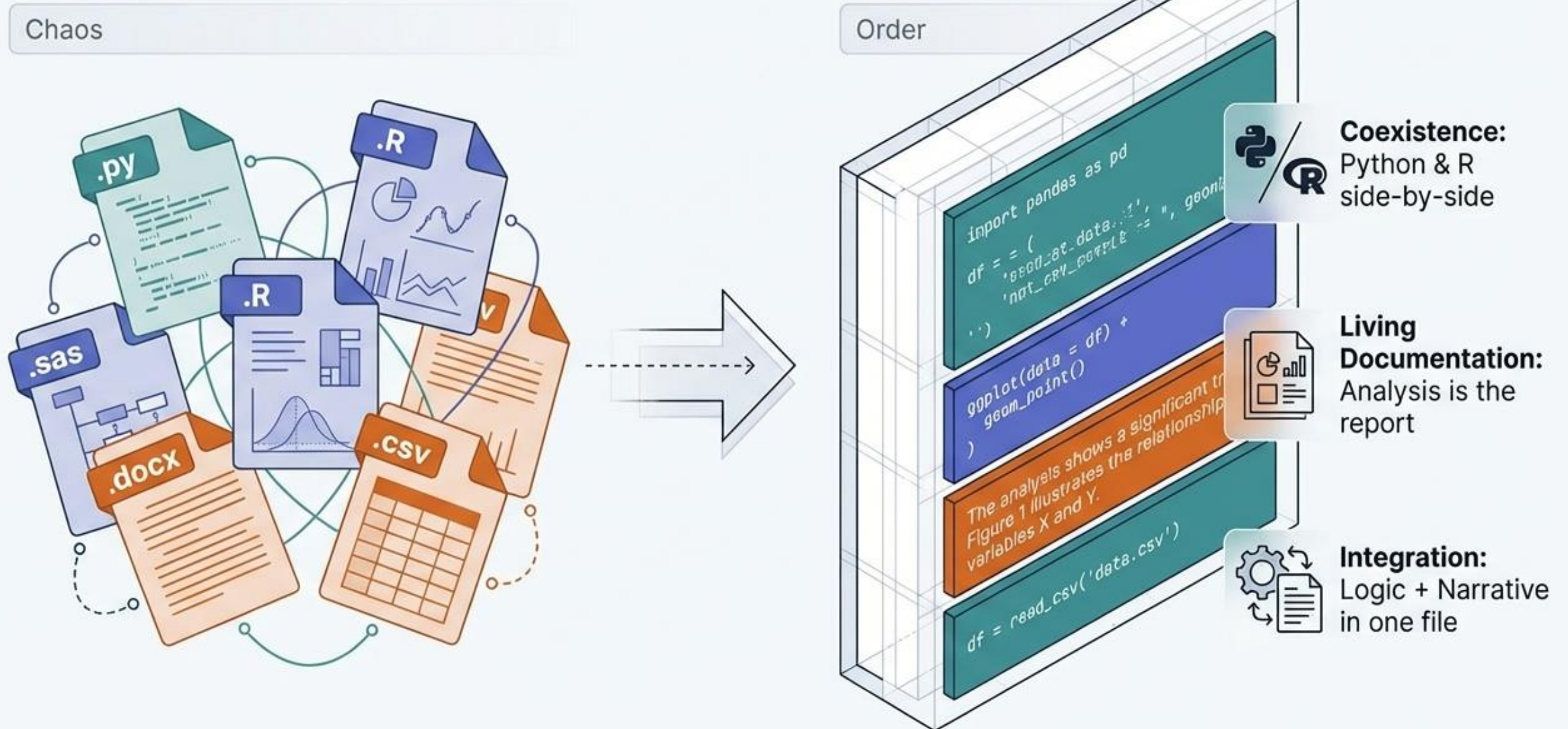
Agenda

- Overview of Clinical Data Workflow
- Multi Language Integration
- Data Processing to Interactive Insights
- Integrity & Reproducibility
- References

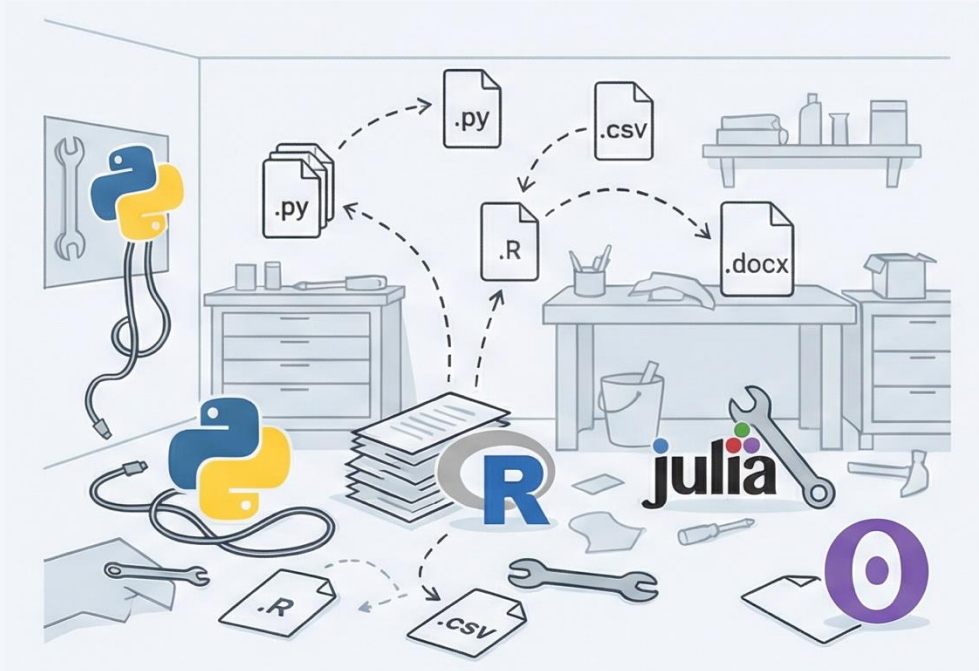
Fragmentation In The Workflow



Breaking Down The Silos



About Quarto



Multi-Engine Support:
Built on Pandoc.

</> Language Agnostic:
Python, R, Julia,
Observable JS.



Tool Flexibility:
Use your favorite IDE.

The “Full Stack” Clinical Workflow



One .qmd document. No intermediate files, no manual handoff.
From Raw data / SDTM to Insight.

Step 1: High-Performance Wrangling With Python



EDC / SDTM

```
```{python}
#| label: clinical-safety-filter
#| tbl-cap: "Summary of Serious Adverse Events in Elderly Cohort"

import pandas as pd

df = pd.read_csv('clinical_trials.csv')

Filter for patients aged 65 and older AND
where the Adverse Event (AE) is marked as Serious (SAE)
sae_elderly = df[(df['age'] >= 65) & (df['seriousness'] == 'Serious')]

We focus on Patient ID, Age, the specific Event, and the Outcome
report_table = sae_elderly[['patient_id', 'age', 'ae_term', 'outcome']]

report_table
```
```

Leverage the Data Engineering strength of Python.

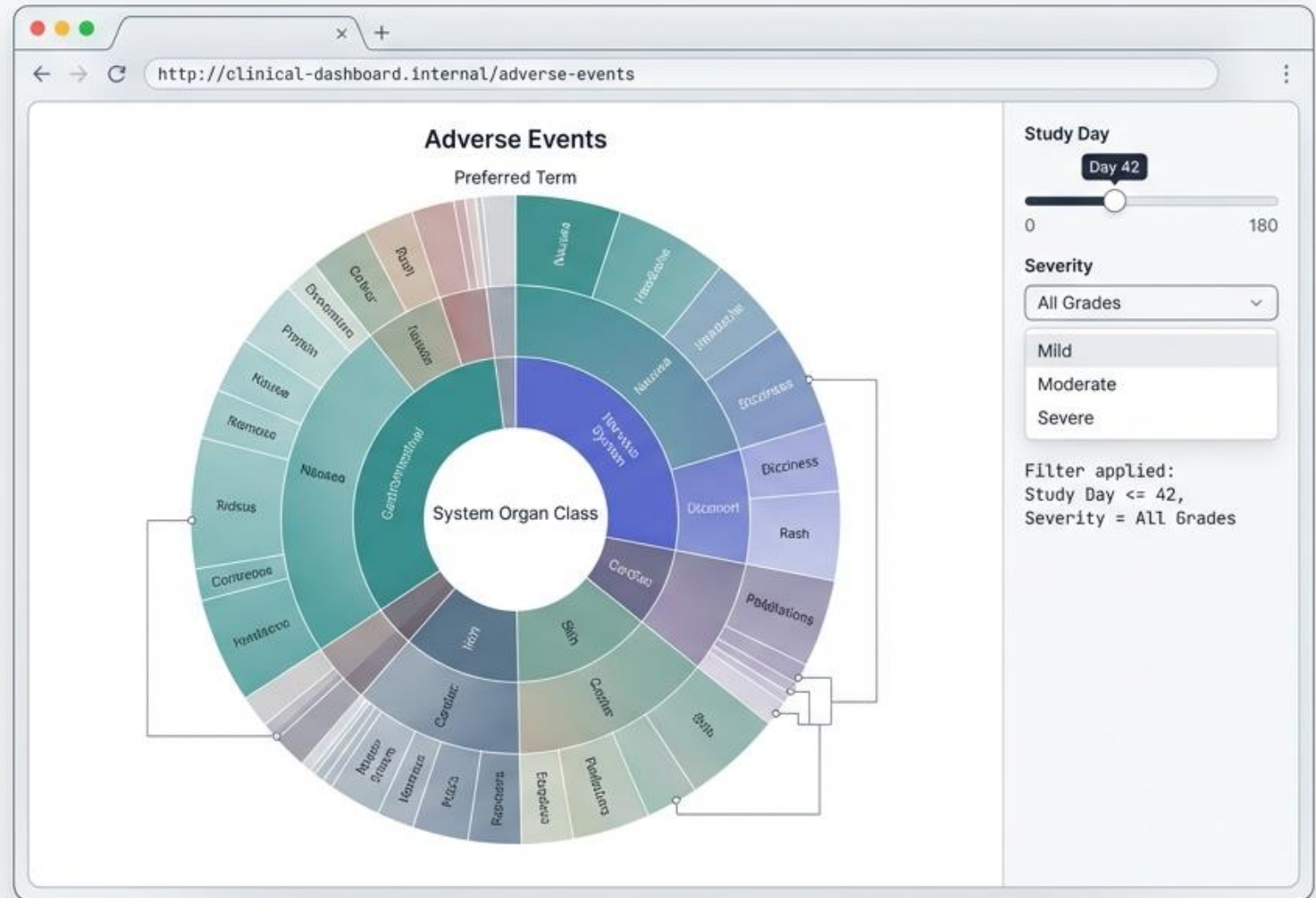
Step 2: Statistical Rigor & TGL Generation with R

- Seamless Multi-Language Data flow, R chunks can directly access datasets residing in memory from previous analytical.
- Quarto automates referencing tables and figures, Easily manage citations.

```
```{r}
#| label: r-tfl-generation
#| message: false
#| warning: false
library(reticulate); library(dplyr); library(gtsummary); library(ggplot2)
1. Access the Python-processed data
clinical_data_r <- py$report_table
2. Table Generation (T): Statistical Summary Table
Creates a publication-ready summary of AE terms and outcomes
clinical_data_r %>% select(ae_term, outcome) %>% tbl_summary(by = outcome,
 label = list(ae_term ~ "AE Term")) %>% add_p() %>% bold_labels()
3. Figure Generation (F): SAE Distribution Plot
ggplot(clinical_data_r, aes(x = ae_term, fill = outcome)) +
 geom_bar(position = "dodge") + theme_minimal() + labs(title = "Fig 1: SAE by Outcome",
 x = "Medical Term (AE)",
 y = "Patient Count",
 fill = "Outcome") +
 theme(axis.text.x = element_text(angle = 45))
```
```

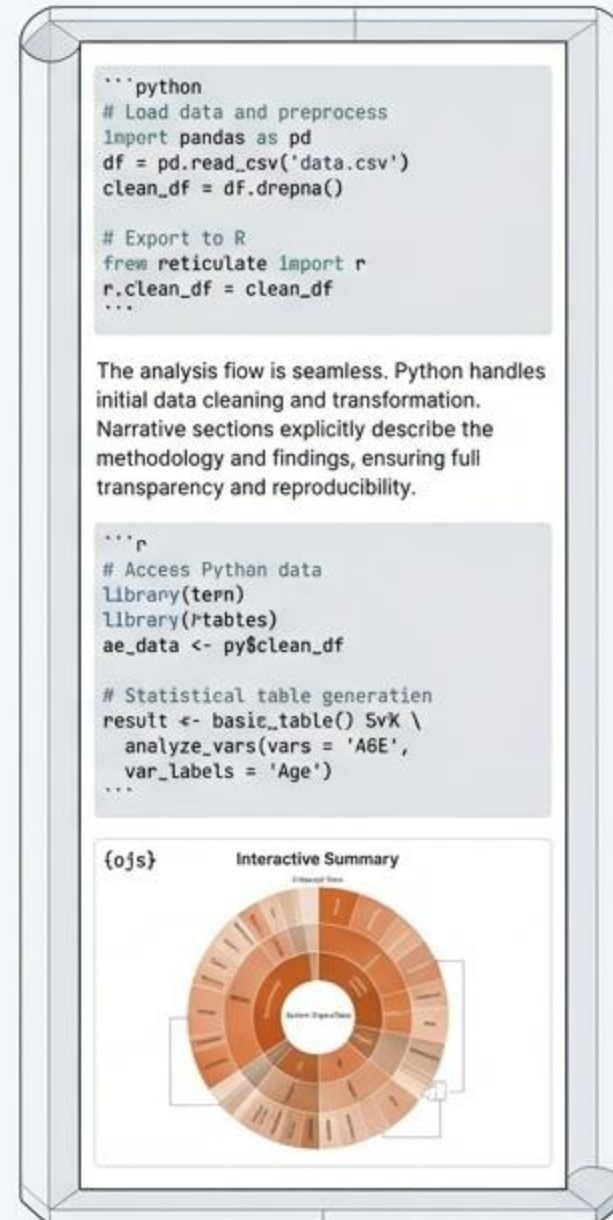
Step 3: Bringing Data to Life with Interactivity

Observable JS (OJS) & Shiny Integration. Drill down from aggregate summaries to patient profiles.



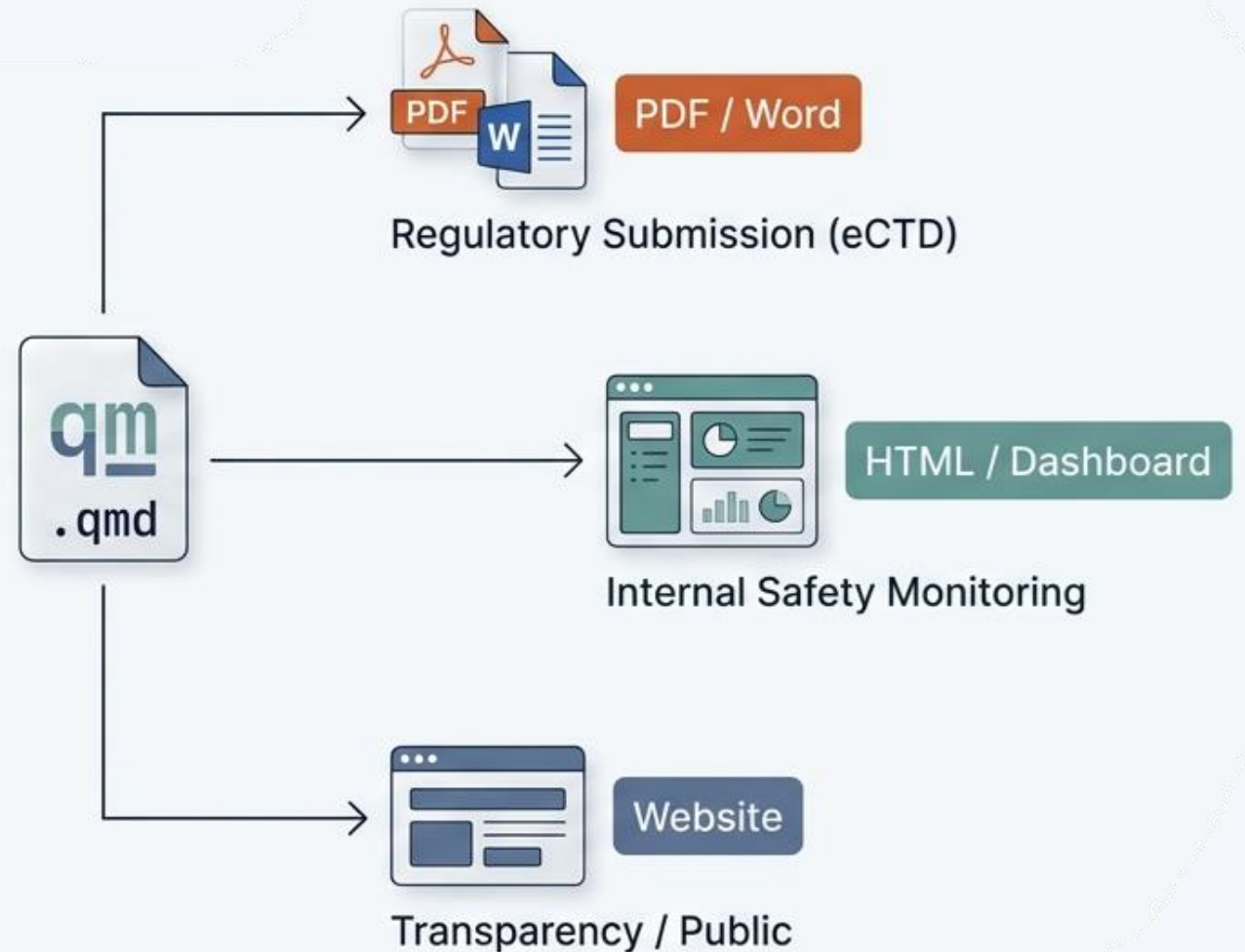
The Unified Document

- One file, Infinite Logic.
- The “Black Box” is eliminated.
- Self-documenting analysis.

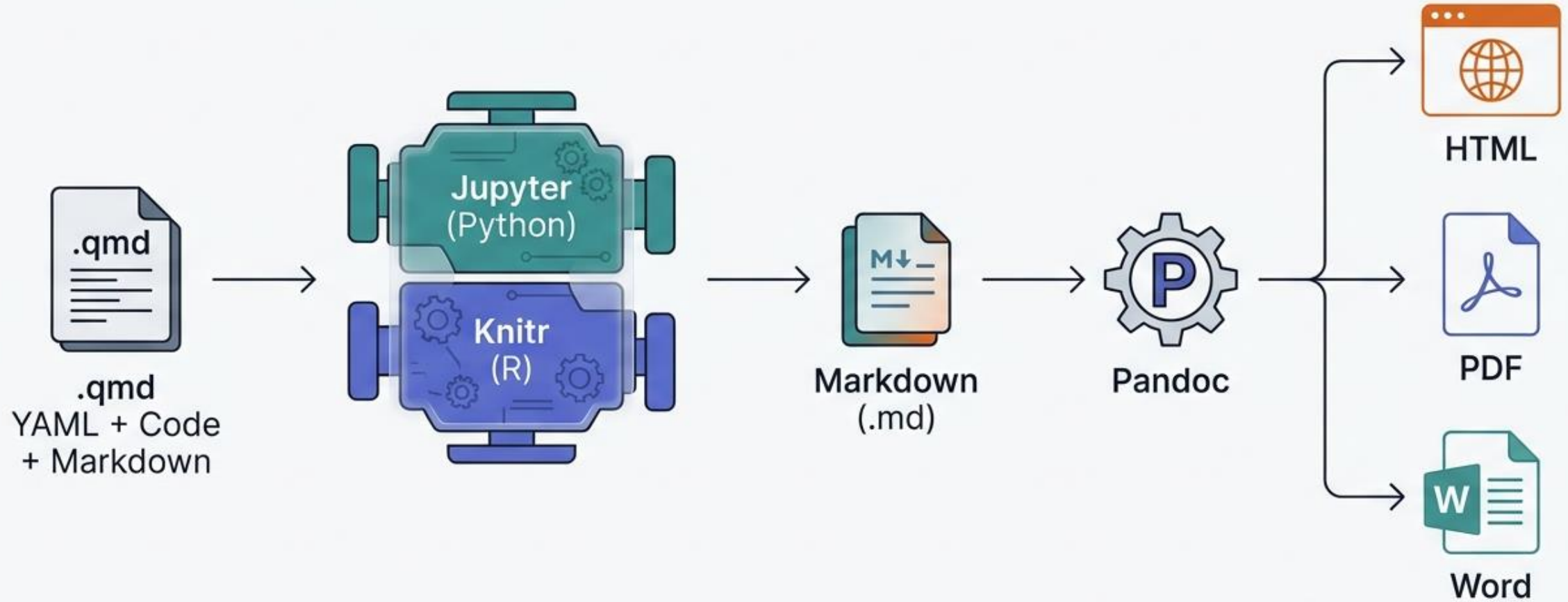


Beyond Dashboard : Multi-Format Publishing

Write Once, Submit Everywhere.
Same code, tailored outputs.

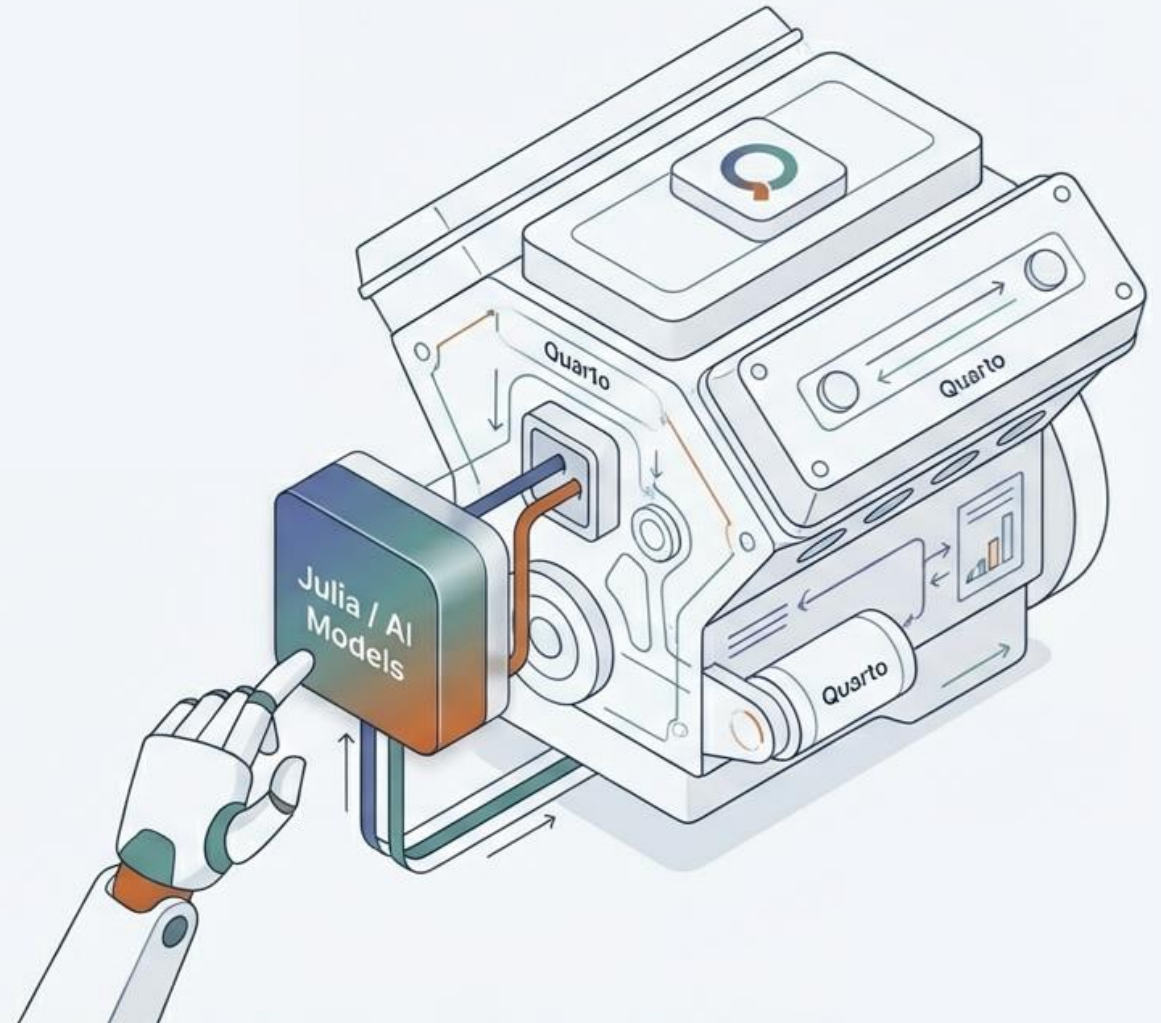


Architecture



Julia & AI Integration

- High-Performance Computing: Native support for Julia.
- AI Readiness: Run prediction models on clinical datasets.
- Adaptability: Evolve with the data science landscape.



Ensuring Regulatory Integrity & Compliance



Version Control

Integrates seamlessly with Git.



Reproducibility

Reproduce the entire document instantly, no copy-paste errors.



Audit Trails

Self documenting Audit trail.

Modernized Clinical Workflow



Analyze. Share. Reproduce.

References

- Quarto Official website (<https://quarto.org/>)
- Python for CSR and Submission (<https://pycsr.org/>)
- NotebookLM

Thank you

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