Appsilon

R Medicine 2023

How Open Source and R/Shiny are Transforming Pharma



André Veríssimo, Ph.D.

Open Source is eating software

76%

of codebase is open source

96%

of apps contain open source components

Anonymized findings from over 1,700 commercial codebases across 17 industries.

Source: OSSRA 2023, Synopsys #1238 Global 2000

Open Source is how Appsilon was born.



Pharmaceutical industry ❤️ R & Shiny



Future is OpenSource

in Pharma, Tech, Finance, ...

Vast library of tools

No need to re-invent the wheel

Low-level tools to building apps

Pharmaverse initiative

End-to-end clinical trials reporting

Lead by Pharma companies

Community

Global community

Support from companies



Challenges in Pharma

from production to clinical trials

Production

Regulatory Compliance reporting

Sales optimization

Connecting data science teams and sales representatives

Drug development

Finding the right dosage for human drugs from in-vitro and in-vivo studies

Drug development

Support research of therapeutics in cancer treatments

Sales representatives

Case study (real-time data)

Clinical practices *dashboard*

- **Excel sheet with clinical practice**
- Slow flow of information between headquarters and representatives
- Low engagement and feedback
- Manual process mapping data

High cost in time and lost opportunities

Sales representatives

Building the solution

Developing and online and offline applications

Connect data science to sales representatives

- Data science teams can **update information in real-time**
- Sales representatives can input metrics of their work and **suggest changes**

Geolocation tools to facilitate day-to-day planning

- Create a timeline for visits to health care providers

Offline access to data as fallback to connection issues

- Inside of buildings
- Poor coverage

Why is R /  a good match?

- **Heavy analytics requirements** and **rich, interactive visualizations**
- Fast prototyping and reached POC early in the project
- Uses mature open source libraries to create a **user-centered** interface
- Shiny excels on **connecting data to frontend**
- Expose data with Plumber to a native Ipad app for offline view

Sales representatives

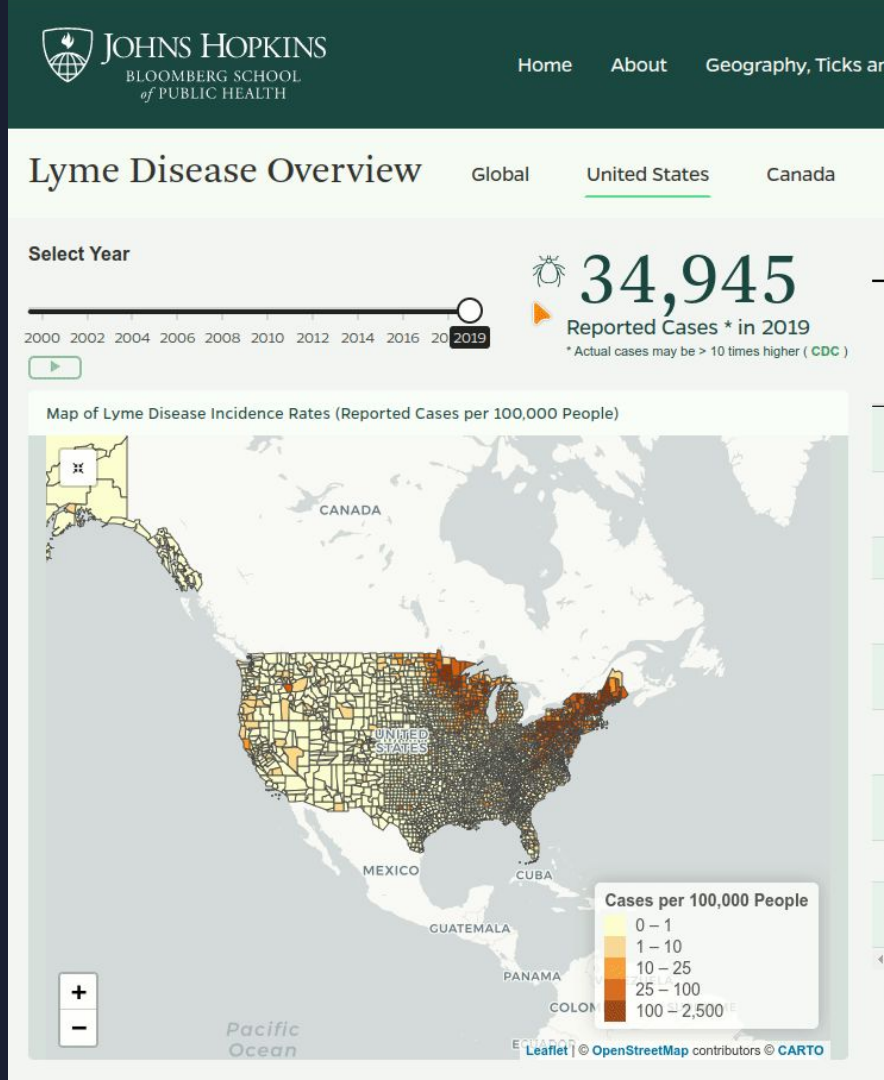
Results & business impact

App **increases engagement** and **leads**

- Increase in-person visits, calls and leads by sales representatives
- More time to engage with health care providers and less time planning
- Connected data science with sales representatives

Johns Hopkins

Lyme Disease



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Regulatory Compliance

Case study

Product review *report*

- **~7 weeks to prepare**
- Once a year
- Multiple sites & GxP compliant
- Manual process integrating data
- Error prone

High cost in time

Batch Quality & Anomalies *report*

- **~5 hours to prepare**
- Regular reporting
- Multiple sites & GxP compliant
- Manual process integrating data
- Error prone

Financial losses when anomalies went undetected

Regulatory Compliance

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Regulatory Compliance

Building the solution

Developing 2 apps with similar challenges

Data intensive tasks

- Retrieve from databases and other sources
- **Standardize workflow** to process the data

Automation

- **Real time information**
- **Reproducible** reports (same data, creates the same results)

Exploratory

- **Preview** charts and tables **as they will appear in the report**
- Change parameters that are site-dependent

Why is R /  a good match?

Heavy analytics requirements and **rich, interactive visualizations**

Create reports that are GxP compliant

Export to different formats Markdown templates and re-usable

On-demand data retrieval directly from databases and calls to APIs

Regulatory Compliance

Results & business impact

Apps **saved millions of dollars** in:

- Saved production manager’s and team’s time
- Better morale, people stay longer with organization
- Faster decision-making that minimizes inventory issues

Applications further deployed to multiple sites, boosting ROI even higher.

Encodings

Datasets: Subject, Time To Event

Select Endpoint

Dataset: ADTTE

Filter by

OS

Analysis Variable

Select AVAL

Censor Variable

Select CNSR

Facet Plots by

Dataset: ADSL

Select

- Nothing selected -

Select Treatment Variable

Dataset: ADSL

Select

ARM Description of Planned Arm

Compare Treatments

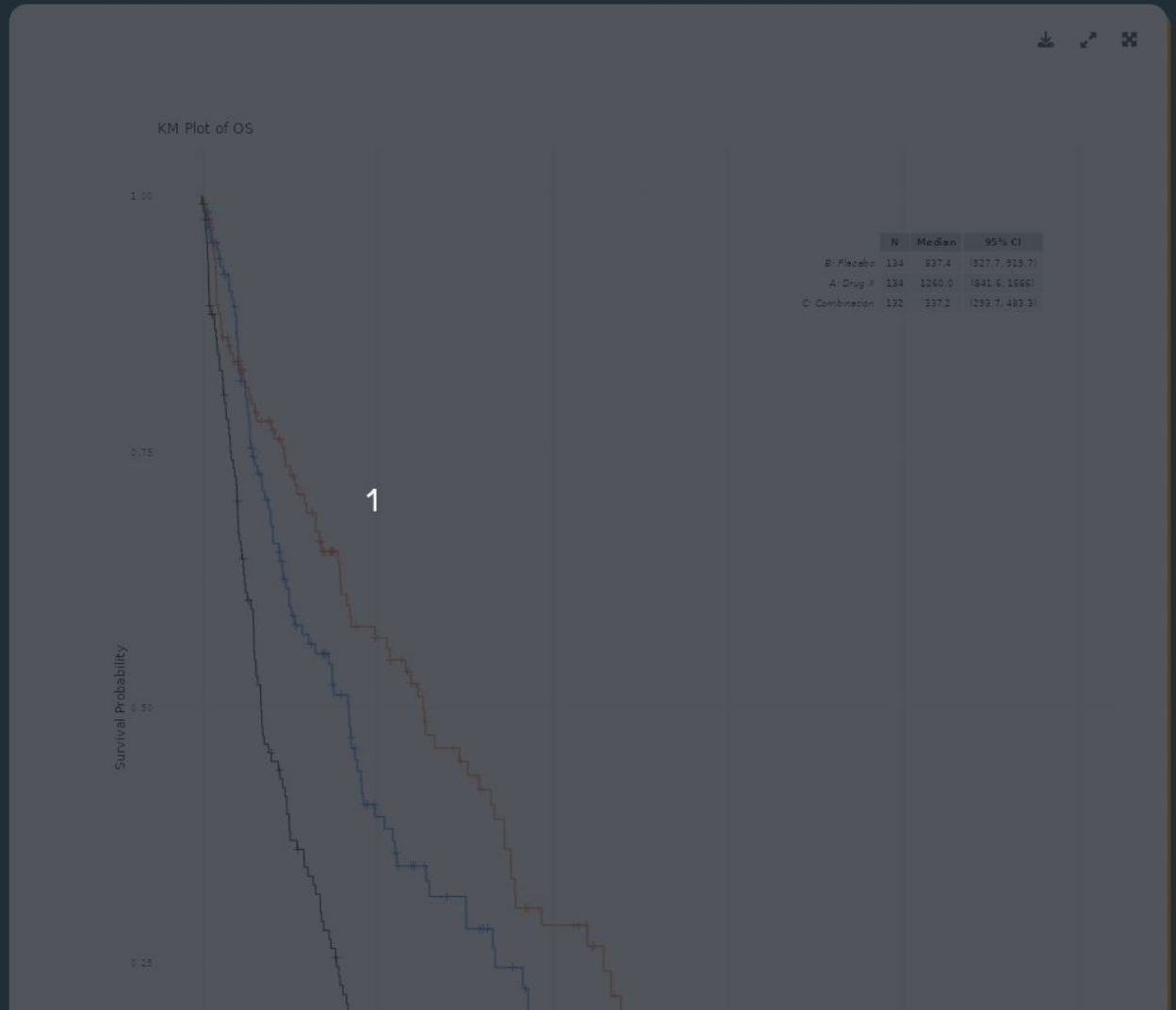
ON

Groups

Ref: B: Placebo

Comp: A: Drug X C: Combination

Combine all comparison groups?



Data Validation Report

Failed | Display errors and warnings only | 2021-05-14 17:00:00 ET

This is a proof of concept of data.validator report using shiny.fluent React.js components from Microsoft Fluent UI library

Validation Results | Code

mtcars

Motor Trend Car Road Tests

- ✓ No NA's inside mpg:carb columns
- ✗ am values equal 0 or 2 only — Inspect invalid data
- ✓ gear and carb values should equal 3 or 4
- ✓ Each row sum for am:vs columns is less or equal 2
- ✗ Each row sum for am:vs columns is less or equal 1 — Inspect invalid data
- ✓ For wt and qsec we have: abs(col) < 4 * sd(col)

Drug development PK

Case study (unified dashboard)

💊 Explore/simulate drug dosage

- **Proccess starts with excel file**
- Weeks-long exchange of files and scripts
- Manual process to import/validate data
- Animal data from multiple contractors
- Simulations and calculations not validated

Manual intensive process

Includes:

1. Human dose Prediction
2. Allometric calculations
3. Monte Carlo Simulation
4. Compound analysis & prediction

(tens of thousands of compounds)

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Drug development PK

Building the solution

Developing application that implements multiple analysis / reporting

Data intensive tasks

- Import data from multiple sources and contractors

Certify the process

- **Validate all** calculations, models and predictions
- Results are reproducible

Collaboration

- **Multiple stakeholders** can contribute to analysis and reporting
- Report configuration/layout can be imported and exported

Why is R /  a good match?

Data heavy process with multiple import, validation, and processing pipelines

Existing R libraries implement majority of functionality

Analytics requirements and rich interactive visualizations

Reports that are GxP-compliant

Drug development PK

Results & business impact

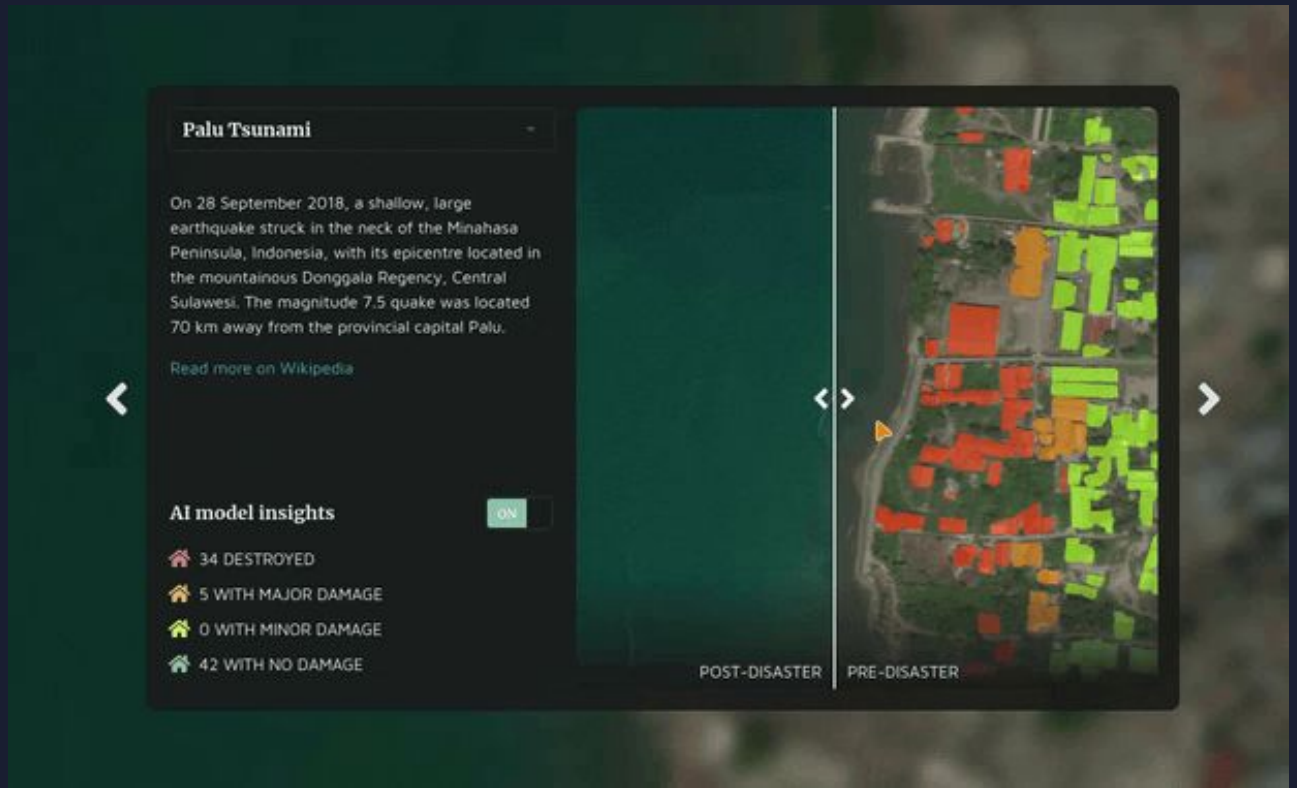
App allow for a **better-informed decision making** process

- **Accurate decision-making** on drug dosage
- Faster collaboration cycles
- **Smoother omboarding** process with single dashboard that is well tested

Disaster Assessment AI & Dashboard

PyTorch + Shiny

Upload image pair and
get assessment in real-time



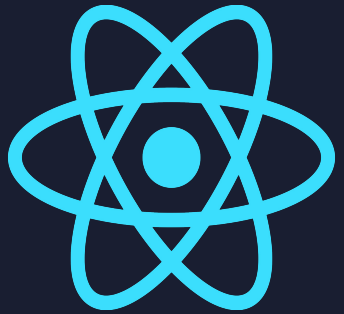
Demo using.

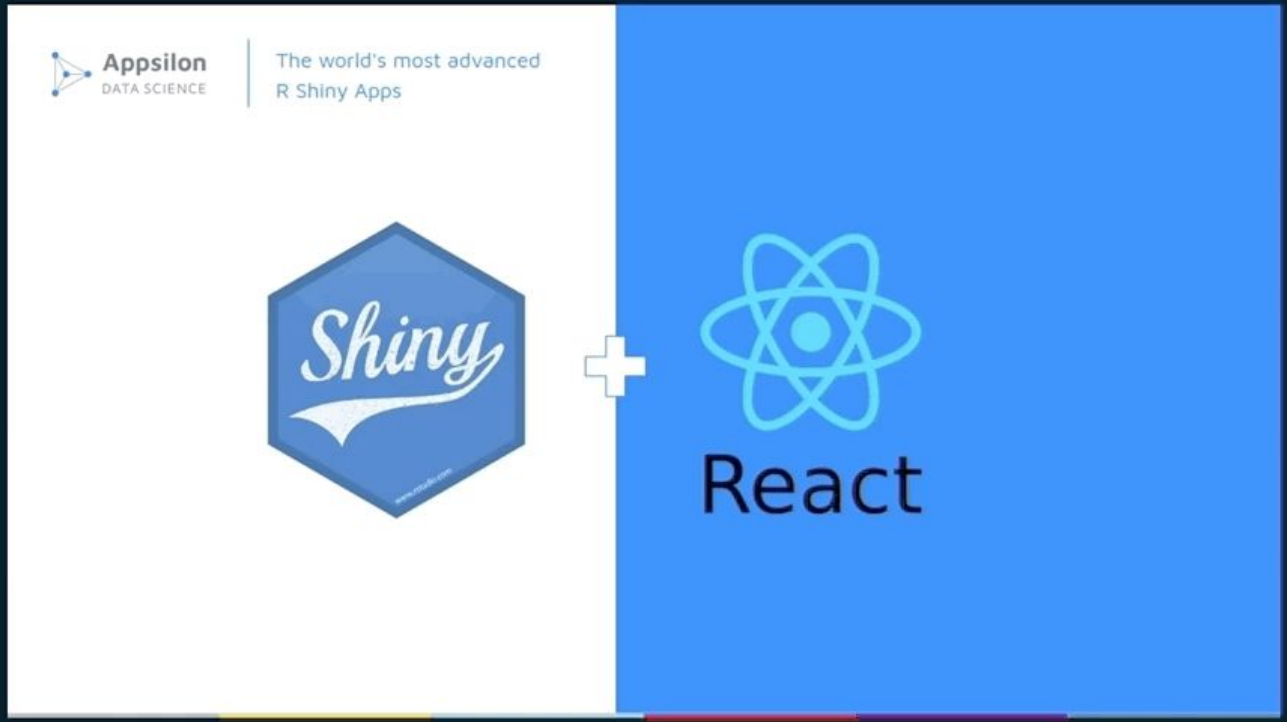
Javascript is native to Shiny

React is also! using Shiny.react library *(by Appsilon)*

Anything that can be done using javascript can be integrated seamlessly in Shiny



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DATA SCIENCE
The world's most advanced
R Shiny Apps
Shiny
React

What connect all case studies?

Automation | Built around the user | Vision from within | Value from Open Source



Countless hours that were no longer needed to perform **repetitive and laborious tasks**

Focus is redirected to activities that are **valuable to the business**

What connect all case studies?

Automation

Built around the user

Vision from within

Value from Open Source



Interface is a gamechanger

Understanding and designing for end users is **critical for success**

What connect all case studies?

Automation | Built around the user | **Vision from within** | Value from Open Source



R/Shiny allows data science teams to develop a **prototype** of **their vision**

Provides supports **fast development**, R data analysis packages, and **visualization libraries**

What connect all case studies?

Automation

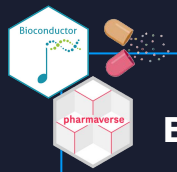
Built around the user

Vision from within

Value from Open Source



Global community that works to improve ecosystem



Bioconductor, **OpenPharma** & **Pharmaverse**

Talent pool from universities

Appsilon &



Company Information



Established in 2013
10 years of excellence



Remote first worldwide company



We work with Fortune 500 companies in various time zones



Dedicated Team of
80+ World Class specialists

data scientists, full stack developers, front-end developers, graphic designers, software architects, infrastructure engineers

Company Information

150+

Projects delivered

200+

Commercial Shiny Dashboards

700+

Concurrent users for a single Shiny dashboard

Keep calm

and live open source.



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