DATA INFRASTRUCTURE FOR SEPSIS RECOGNITION

Implementation & Monitoring

06/05/2019

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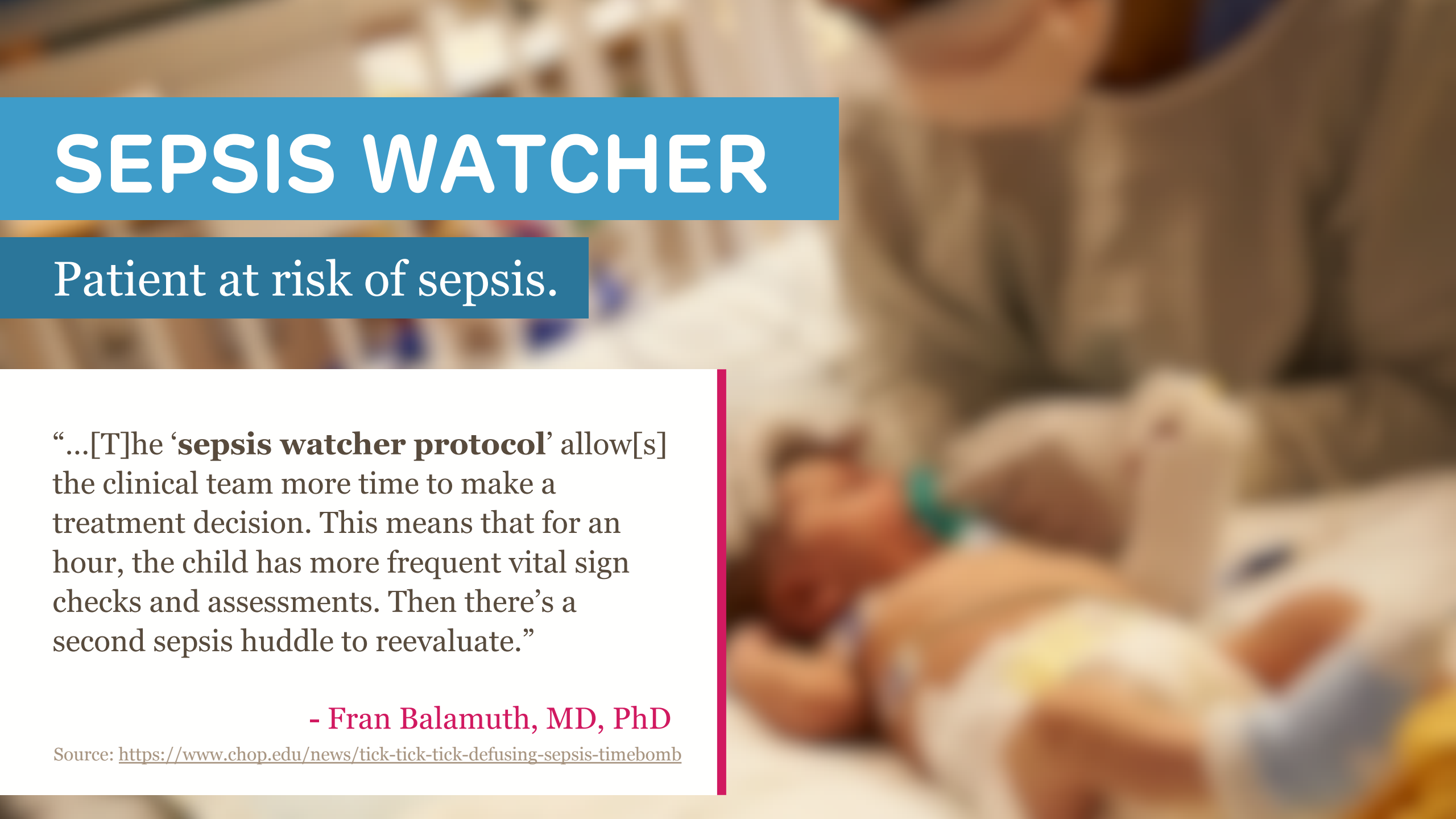

SEPSIS WATCHER

Patient at risk of sepsis.

"...[T]he '**sepsis watcher protocol**' allow[s] the clinical team more time to make a treatment decision. This means that for an hour, the child has more frequent vital sign checks and assessments. Then there's a second sepsis huddle to reevaluate."

- Fran Balamuth, MD, PhD

Source: https://www.chop.edu/news/tick-tick-tick-defusing-sepsis-timebomb

SEPSIS AVENGERS

Sharon Kaminski	Paul Wildenhain	Christian Minich	Joe Mirizio
Improvement Advisor	Data Analyst	Data Engineer	Data Developer

SEPSIS PROJECT OVERVIEW

STRATEGY

PHASE I

Improve Treatment-Related Metrics

PHASE II

Measure Sepsis Outcomes

PHASE III

Improve Early Sepsis Recognition

ORGANIZATION

9 Projects & Metrics

PICU/ PCU	NICU	ED	Cardiac	Med. Surg.	Screening	Outcome Metric
Department Leadership					Working Group Advisory	
Coordinating Council						

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DATA ECOSYSTEM • PAST

🐋 Monolithic Dashboard

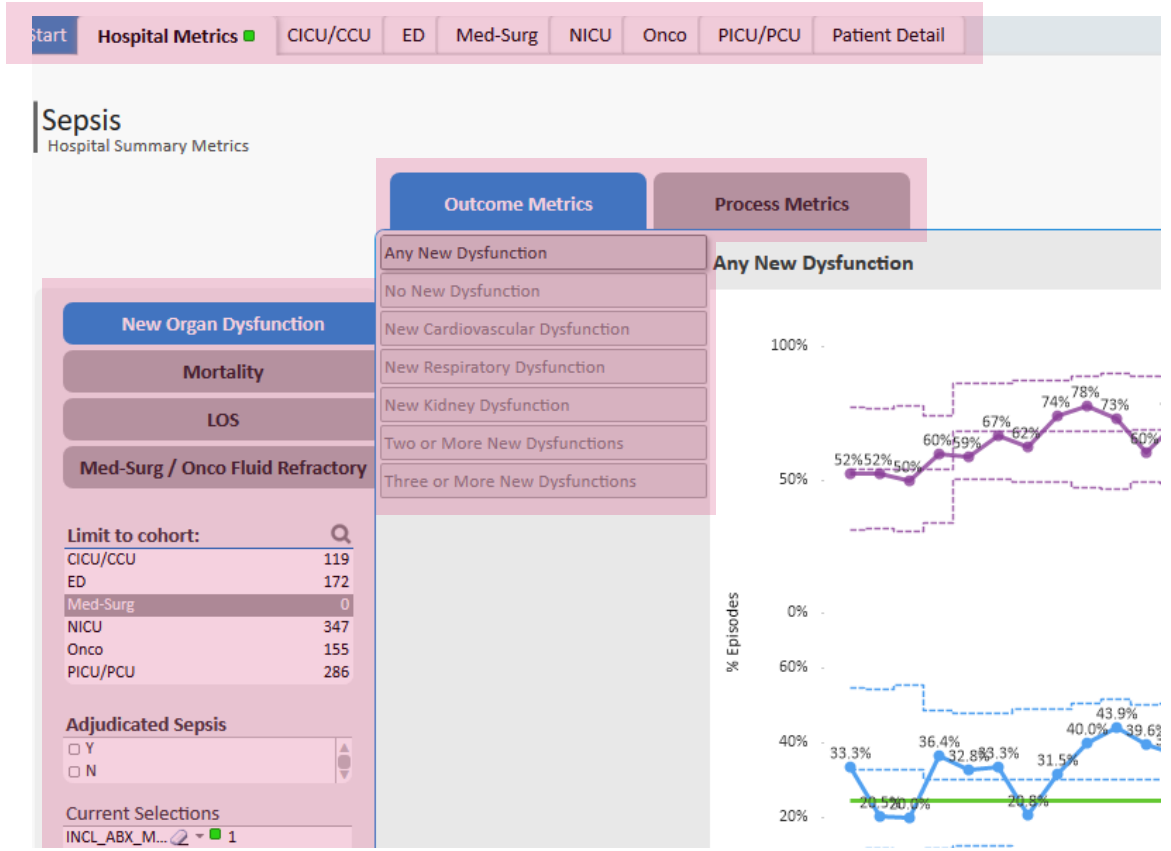
- User agnostic
- Overloaded functionality
- 41 views x 4 filters

Ad Hoc Data Pulls

- Daily? Weekly? Monthly?

🧗 Rigid Data Mart

- 2 weeks for *minor* changes



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5 RIGHTS OF CDS

1. 📒 **Information** - Limited to teams needs
2. ↔️ **Intervention Format** - Push & pull
3. 👩‍💼 **Person** - Not everyone gets email
4. 📩 **Channel** - Email, dashboard, ad-hoc report
5. ⏰ **Time** - Pushed at appropriate frequency

Utilized this approach as a framework for data ecosystem.

Source: https://healthit.ahrq.gov/ahrq-funded-projects/current-health-it-priorities/clinical-decision-support-cds/chapter-1-approaching-clinical-decision/section-2-overview-cds-five-rights

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DATA ECOSYSTEM • CURRENT

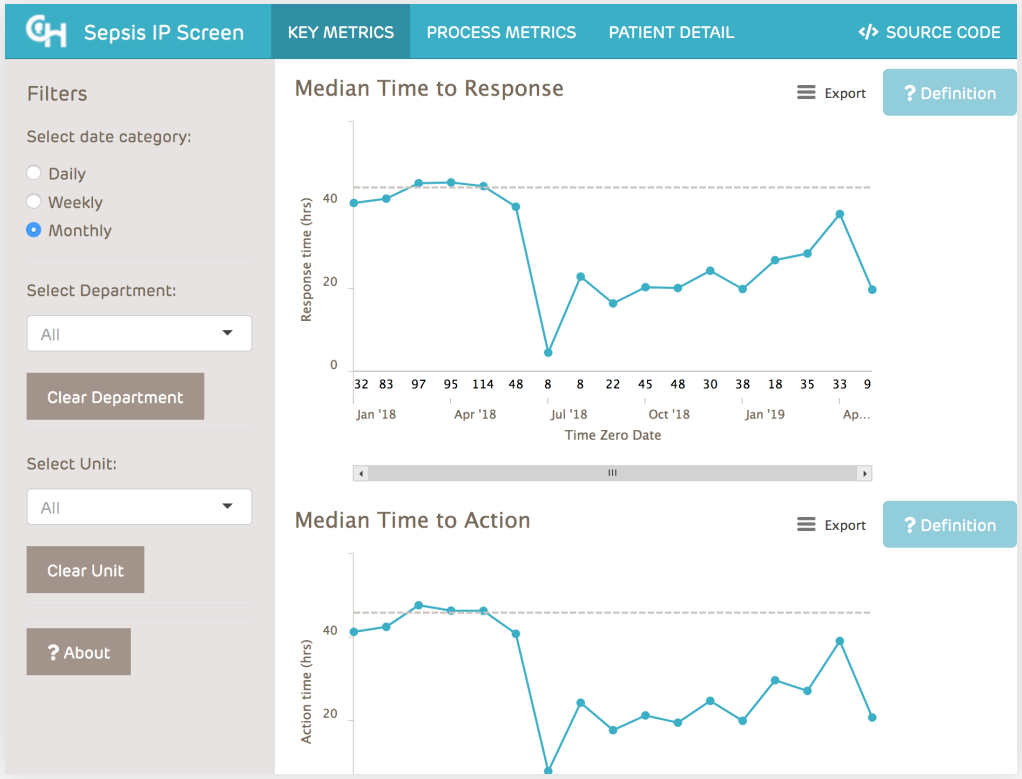
📩 **4** Automated Emails
- Pushed at appropriate frequency

📈 **3** Dashboard & Reports
- Ad-hoc analysis still important

🔧 **2** Data Pipelines
- REDCap → Data Warehouse

💾 **1** Sepsis Data Mart (“Automart”)
- Analyst-driven change

👩 **0** Data-Deprived Physicians



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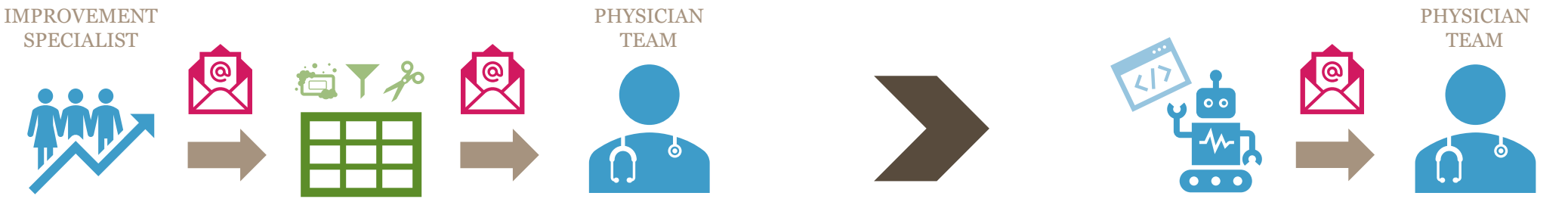
EXAMPLES

SEPSIS SCREENING REPORT

Identify adherence to sepsis screening best practice workflow for at-risk patients.



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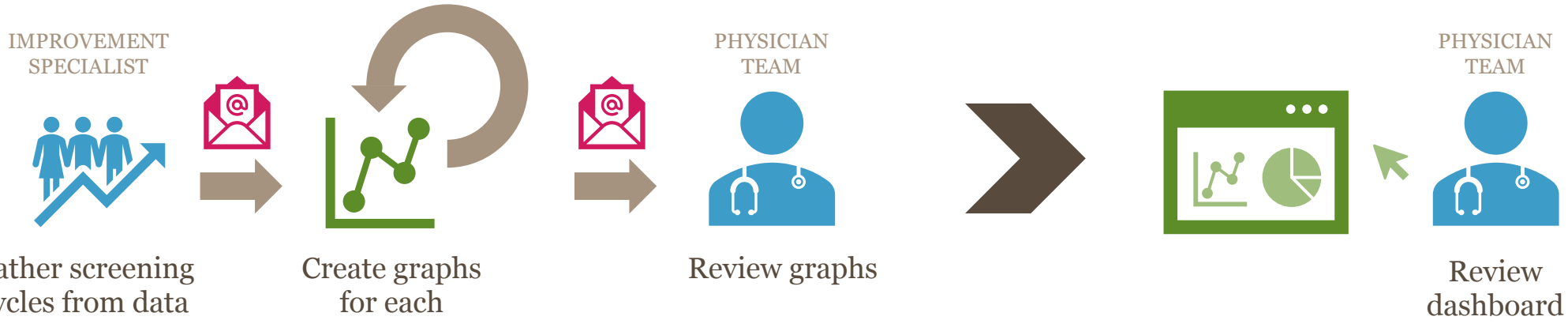
SEPSIS SCREENING DASHBOARD

Display which departments adhere to the established guidelines around time-to-care.



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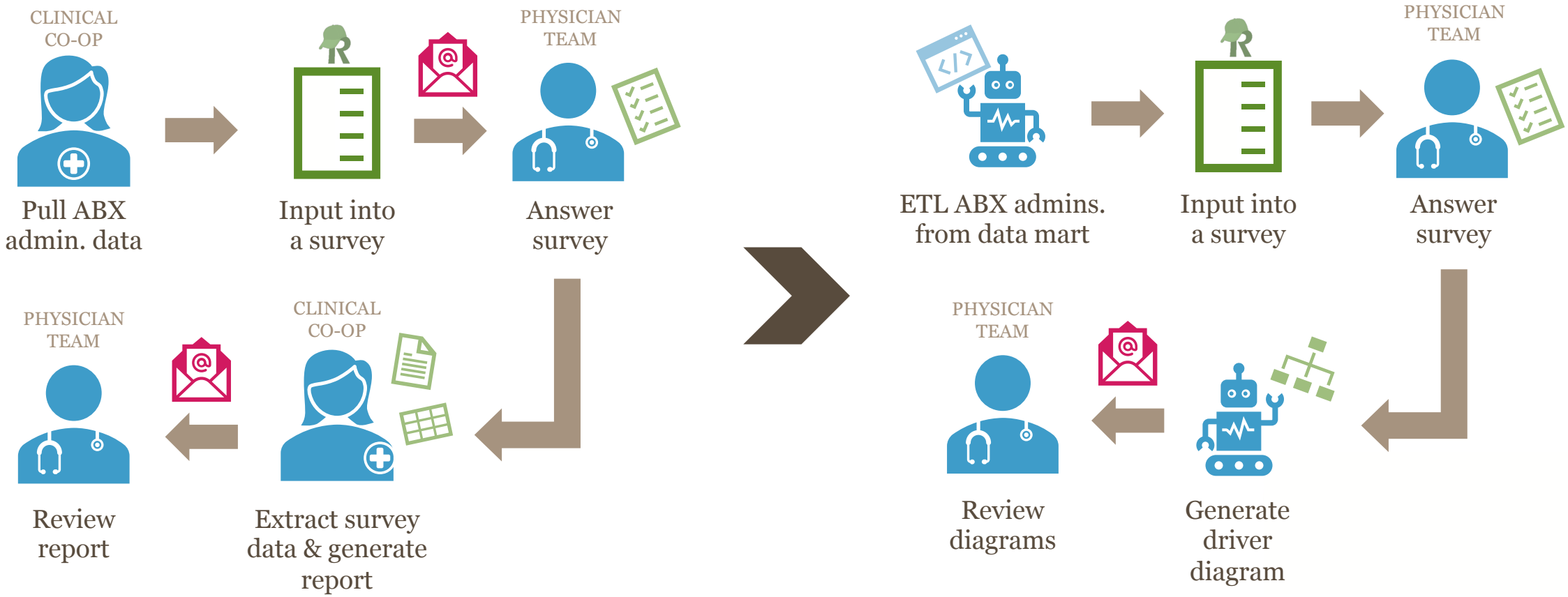
LONG ANTIBIOTICS SURVEY

Explain barriers to timely sepsis care.

(i.e. Antibiotics administration)




INFRASTRUCTURE
STRATEGY

DATA PROBLEMS

☝ Analysts had one distribution tool

- "Qlikview" synonymous for "published data"

Data mart changes go through IS

- Led analysts to push logic to BI tool

🤝 Project handoff

- Analyst have idiosyncratic practices
- Domain knowledge not easily transferable
- Sepsis project handed off 3 times

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DATA PRINCIPLES

🔑 Analyst-owned data workflow
- Unassisted, end-to-end development

👨‍🏫 Prescribed workflows for common problems
- Need to solve [*problem*] → use [*tool or process*]

🛠️ Tools enforce best practices
- Version control
- Configuration-as-code
- Standardized packages

🔭 Enable discovery of analyst work
- Find each other's code & data artifacts

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INFRASTRUCTURE
TECHNOLOGY

GITHUB ENTERPRISE

Enterprise-hosted version control

🤝 Code collaboration

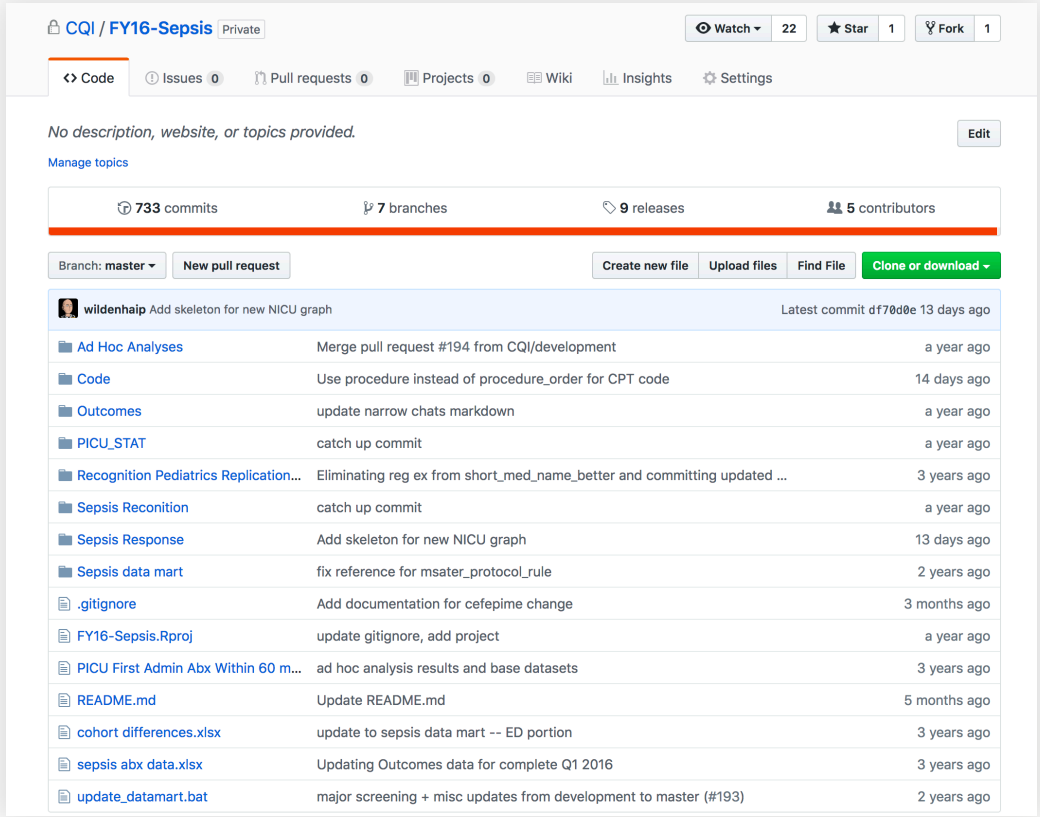
- Pull requests for reviews

🗺️ Discoverability

- Search through team's code

🧰 APIs and extensibility

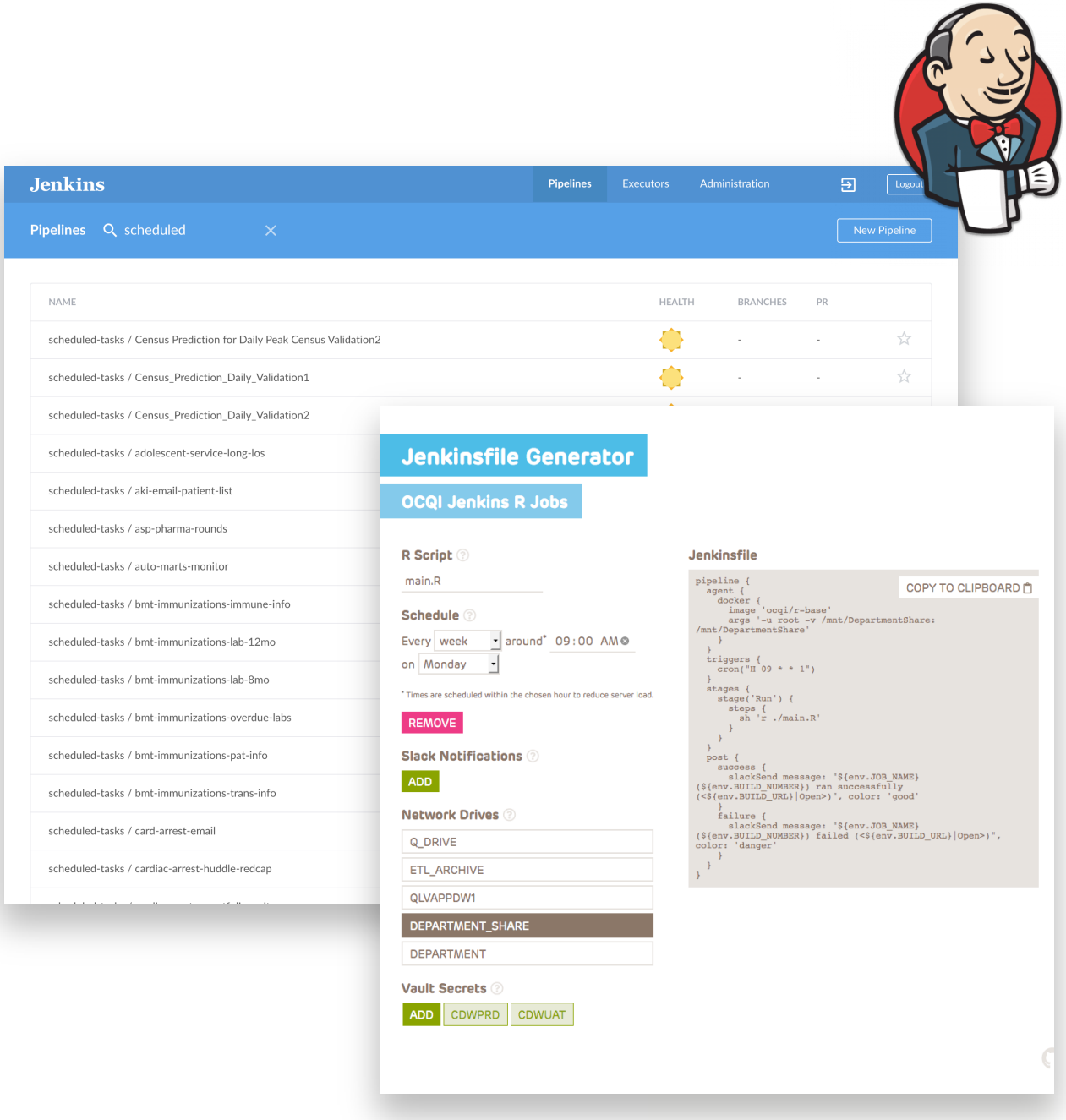
- Continuous Integration



JENKINS

Task automation platform

- 🤖 Generic task execution
  - Automated emails
  - Static database loads
  - Continuous integration
- 🔒 Enforces version control
- 📓 Configuration-as-code
  - via `Jenkinsfile`



DOCKER

Standard computing environment

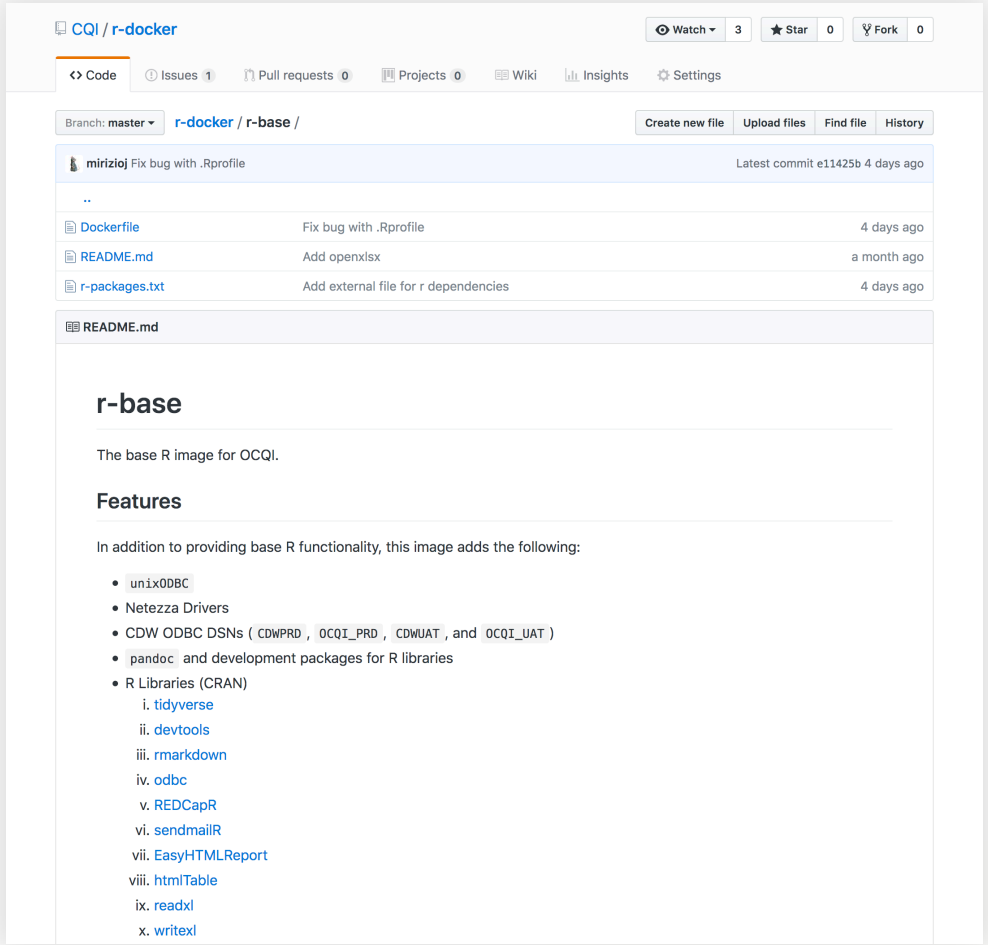
💅 Maintained R images

- `r`
- `r-base`
- `r-with-java`

🚗 Database drivers & config

📦 Standard R packages

- e.g. `tidyverse`



CQI / r-docker

Watch 3 | Star 0 | Fork 0

Code | Issues 1 | Pull requests 0 | Projects 0 | Wiki | Insights | Settings

Branch: master | r-docker / r-base / | Create new file | Upload files | Find file | History

mirizioj Fix bug with .Rprofile — Latest commit e11425b 4 days ago

..

Dockerfile	Fix bug with .Rprofile	4 days ago
README.md	Add openxlsx	a month ago
r-packages.txt	Add external file for r dependencies	4 days ago

README.md

r-base

The base R image for OCQI.

Features

In addition to providing base R functionality, this image adds the following:

- `unixODBC`
- Netezza Drivers
- CDW ODBC DSNs (`CDWPRD` , `OCQI_PRD` , `CDWUAT` , and `OCQI_UAT`)
- `pandoc` and development packages for R libraries
- R Libraries (CRAN)
  i. tidyverse
  ii. devtools
  iii. rmarkdown
  iv. odbc
  v. REDCapR
  vi. sendmailR
  vii. EasyHTMLReport
  viii. htmlTable
  ix. readxl
  x. writexl

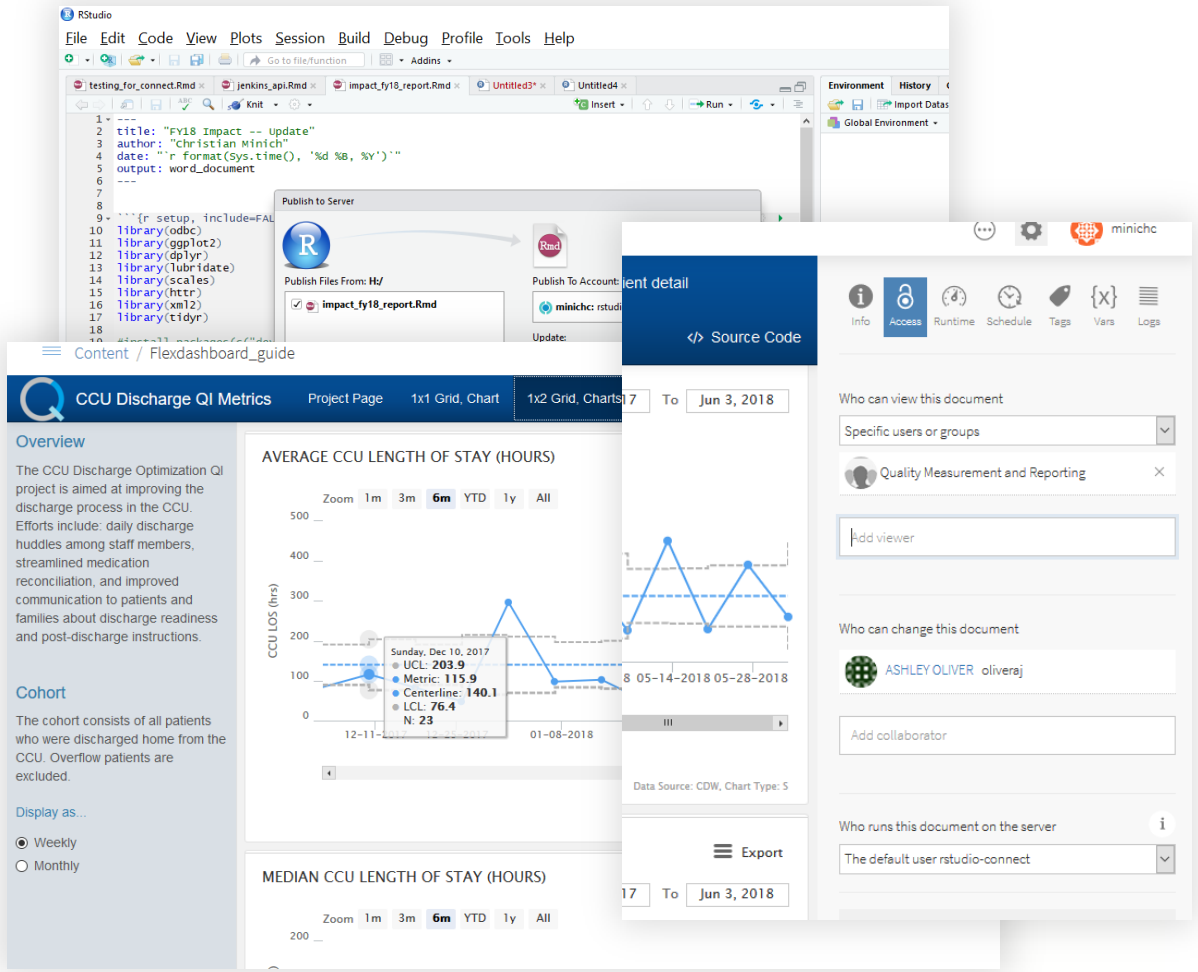
RSTUDIO CONNECT

Publishing platform for R

👇 "Push button" publishing
- via RStudio (IDE)

📦 Package management
- via `packrat`

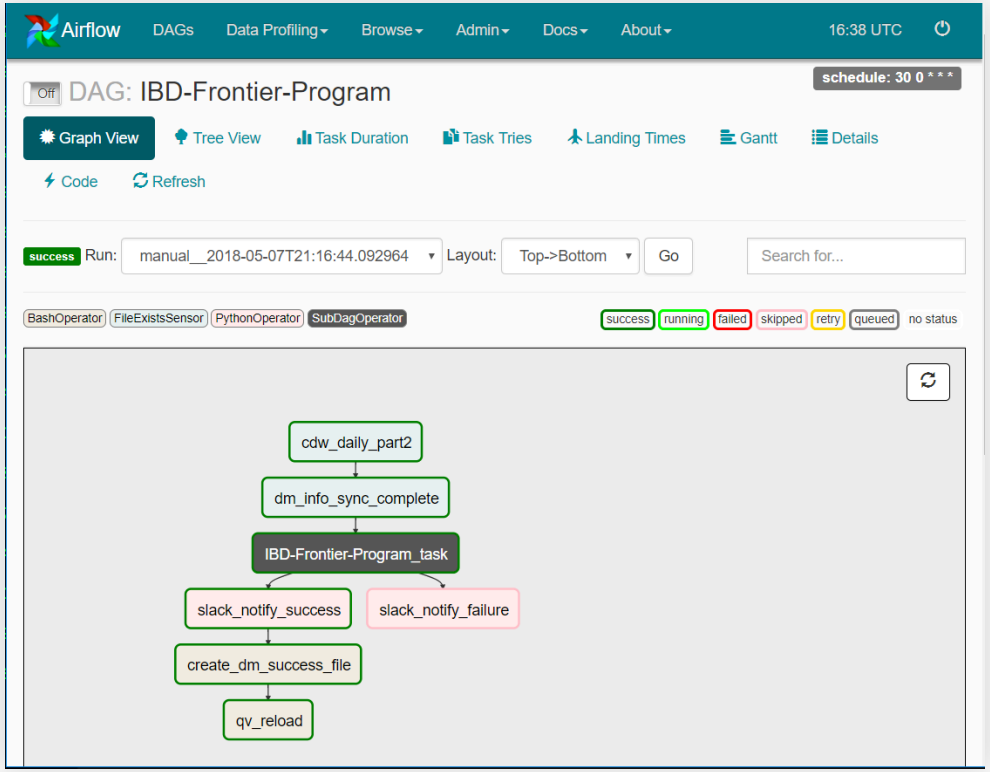
👮 User-authenticated content
- Works with LDAP



AUTOMARTS

Automated data mart creation

- 💨 Airflow jobs create data marts
  - DAGs scheduled daily
- 📖 Reads SQL from GitHub
  - Auto-discovered dependencies
- 📳 Feedback via Slack



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DATA SOLUTIONS

TECHNOLOGY RECIPES

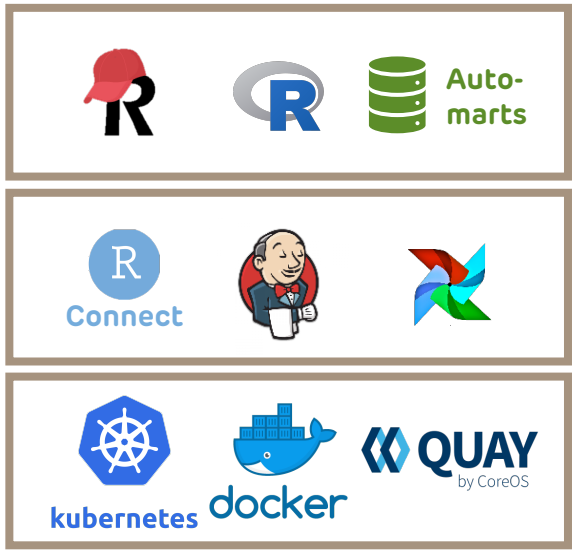
Dashboard = R Connect + Auto-marts

Email = R Connect + Auto-marts

= R docker + Auto-marts + Jenkins

Data Pipeline = R docker + Auto-marts + Jenkins + R

TECHNOLOGY STACK



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NEXT STEPS

📦 Create a catalog of data artifacts

- Diaspora of project repositories & different artifact types are difficult to search through

🤖 Build standard artifacts via automation

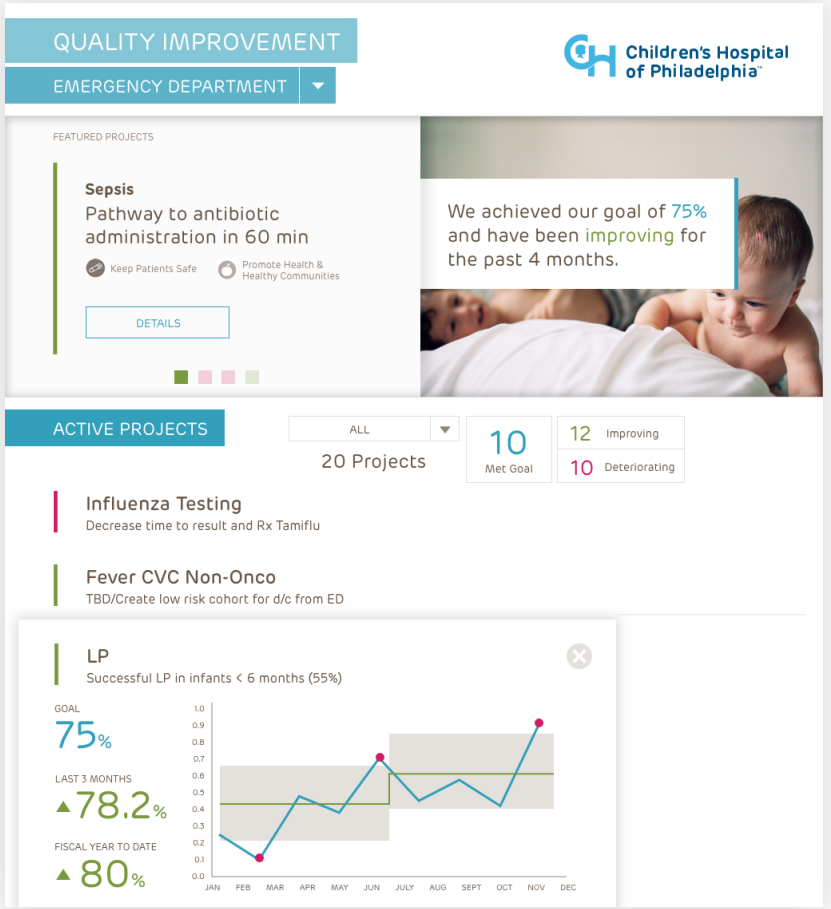
- Eliminate need to create routine data products (e.g. patient lists & metric SPC charts)

📜 Develop operationalization strategy

- "You build it, you maintain it" – not sustainable

👷 Continue productionizing infrastructure

- Harden & scale as needs grow



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SO YOU WANT TO DO THIS…

📚 Established centralized IS resources

- Servers to host applications
- SaaS & CaaS - *Quay, Kubernetes, Vault, etc.*

👩‍👧 Investment in personnel required

- Cross-functional team:
  Analysts, engineers, developers, & users
- 2-3+ data engineers & developers
- Full-stack analysts – *total workflow ownership*

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SUMMARY

👑 Sepsis data support went from rags to riches

- Saves clinical team 10+ hours every week

5️⃣ Cross-functional teams enable 5 Rights of CDS

- Developers design & build infrastructure →
- Analysts rapidly deploy reliable data artifacts →
- Improvement specialists & clinicians save time

💰 Large investment, but we'd do it again!

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