

Set It and Forget It

Enabling Dashboards Using Database Connections in R

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August 6, 2019

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Disclosures

Related to the content of this talk:

- None

Other disclosures:

- Travel support from Roche Diagnostics

The relational database is a key component of most healthcare analytics infrastructure

| PatientID | MRN | FirstName | LastName | Order ID | Order Code | Order Name | Accession | Tube |
|-----------|---------|-----------|----------|----------|------------|----------------------|-----------|-----------------------|
| 23 | 123456 | John | Smith | 101 | CBC | Complete Blood Count | 5679 | LAV |
| | | | | | PatientID | OrderID | OrderCode | OrderName |
| 24 | 098765 | Jane | Doe | 102 | 23 | 101 | CBC | Complete Blood Count |
| | OrderID | Accession | Tube | | | | | |
| 24 | 101 | 5679 | LAV | 103 | 23 | 102 | BMP | Basic Metabolic Panel |
| 24 | 102 | 5680 | GRN | 104 | 24 | 103 | BLDCLT | Blood Culture |
| 24 | 103 | 5733 | BLD | | 24 | 104 | HPTSWKUP | Hepatitis Workup |
| 24 | 104 | 5734 | GLD | 104 | 24 | 105 | CRP | C Reactive Protein |
| 24 | 104 | 5735 | PRL | 105 | CRP | C Reactive Protein | 5812 | GRN |
| | 105 | 5812 | GRN | | | | | |

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Four powerful words: select, from, where, and join

```
select PatientID, MRN, FirstName, LastName  
from patients  
where MRN = 123456
```

| PatientID | MRN | FirstName | LastName |
|-----------|--------|-----------|----------|
| 23 | 123456 | John | Smith |

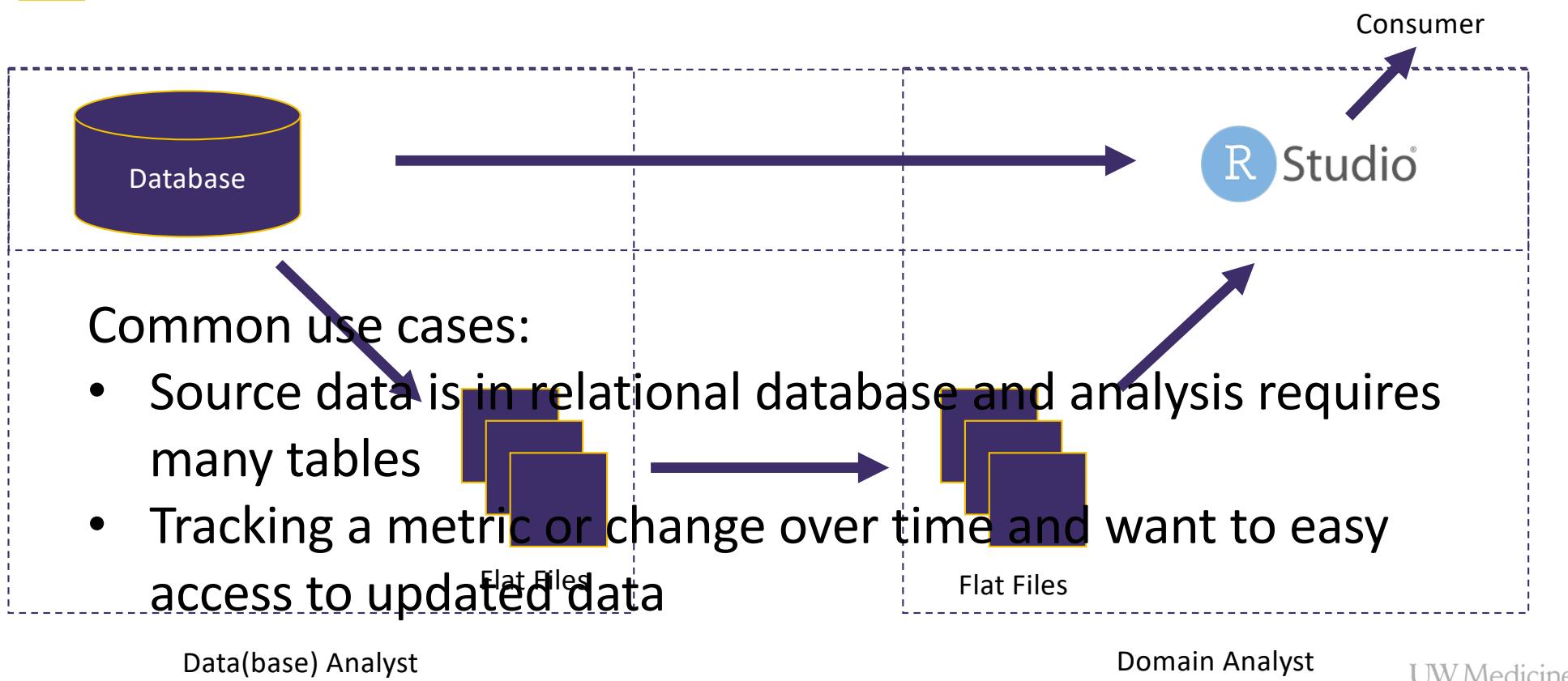
Four powerful words: select, from, where, and join

select PatientID, MRN, OrderID, OrderCode, OrderName
from patients

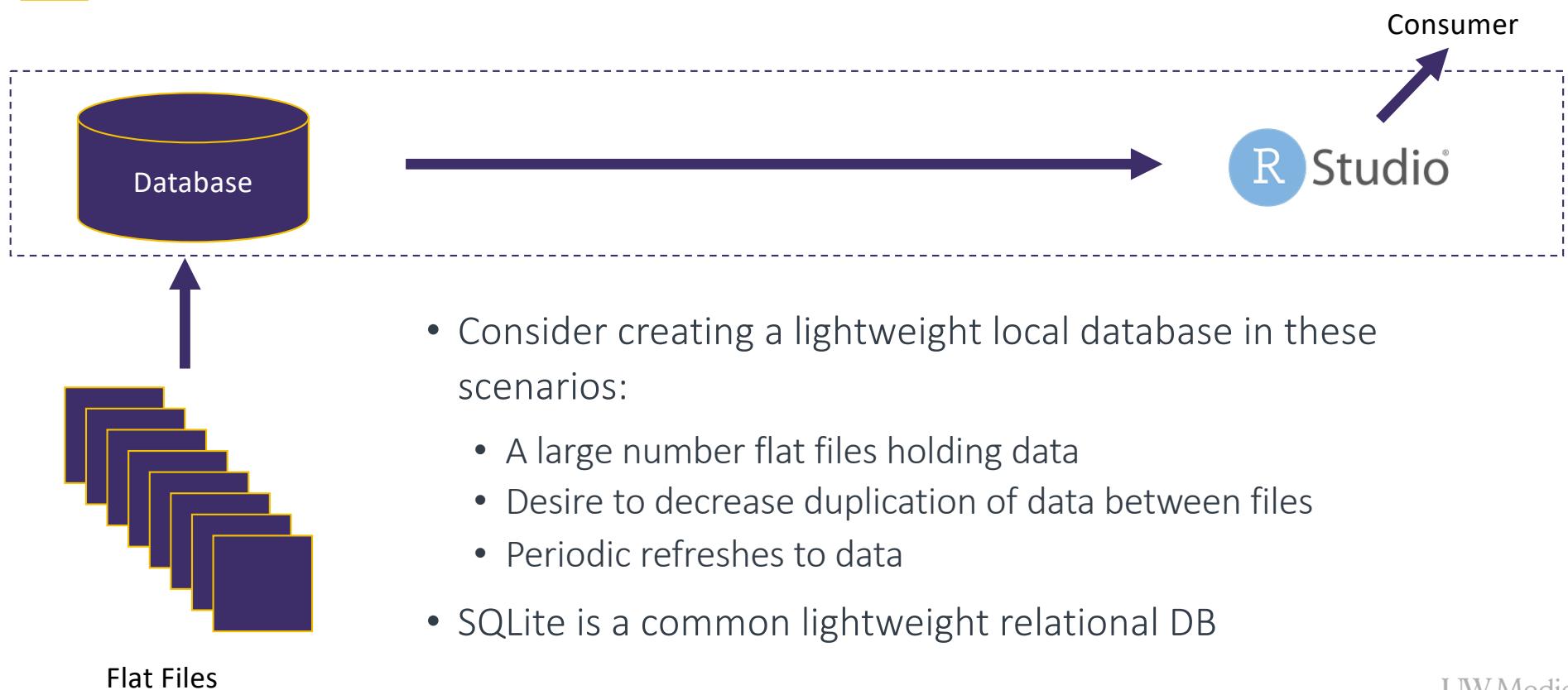
join orders on patients.PatientID = orders.PatientID
where MRN = 123456

| Patient ID | MRN | Order ID | Order Code | Order Name |
|------------|--------|----------|------------|-----------------------|
| 23 | 123456 | 101 | CBC | Complete Blood Count |
| 23 | 123456 | 102 | BMP | Basic Metabolic Panel |

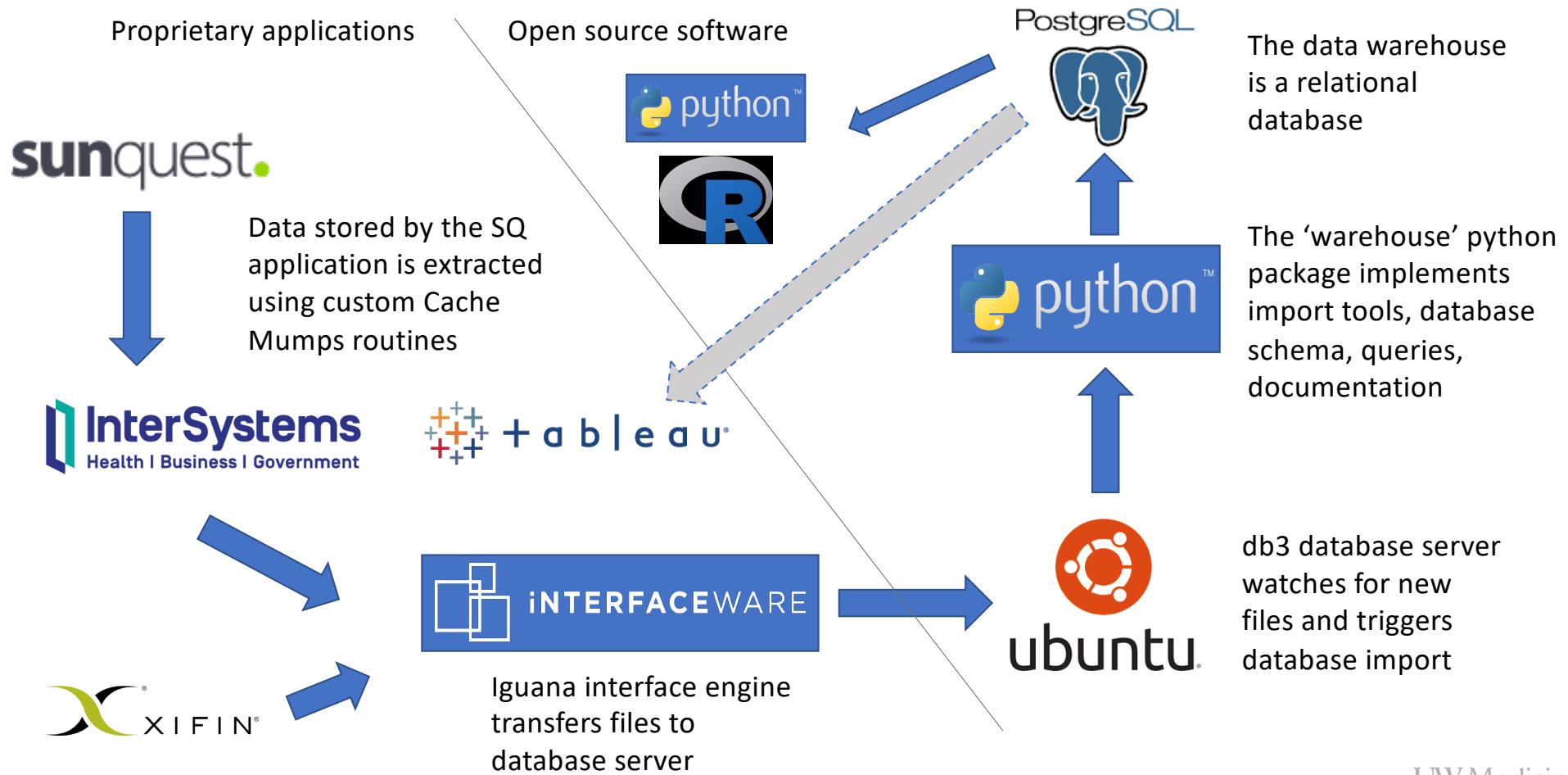
Why connect to a database with R?



What if my source data is not in a relational database?



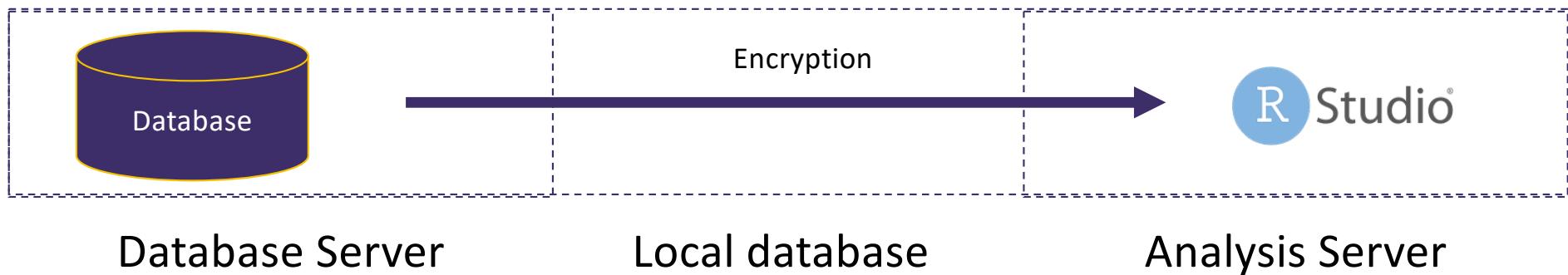
UW Laboratory Medicine Data Warehouse Architecture



Laboratory workflows in one diagram

| | Patient | Provider | Clinic Staff & Nursing | Payor | Test | Sample | Result | Charge | Payment | Patient Location | Laboratory Location | Laboratory Division | Billing Group | Diagnosis/Problem | Ordering System | Cancellation Reason | Denial Reason |
|----------------------------------|---------|----------|------------------------|-------|------|--------|--------|--------|---------|------------------|---------------------|---------------------|---------------|-------------------|-----------------|---------------------|---------------|
| EVENT | who | | | | what | | | where | | | why & how | | | | | | |
| Laboratory Order | * | * | X | | X | | | | | X | | | | X | X | | |
| Sample Collection | X | | X | * | | X | | | | X | | | | | | | |
| Sample Receipt | | | X | | | X | | | | | X | | | | | | |
| Sample Transport | | | X | | | X | | | | | X | X | | | | | |
| Test Performed | | | X | | | X | | | | | X | X | | | | | |
| Test Cancelled | | | X | | | X | | | | | X | X | | | | | X |
| Result Sent | X | X | X | | | | X | | | | | | | | | | X |
| Result Receipt | | X | | | | | X | | | | | | | | | | X |
| Charges Sent (to Billing System) | | | | | | | | X | | | | X | | | | | |
| Bill Sent | | | | | X | | | X | | | | X | | | | | |
| Payment Received | | | | | X | | | | X | | | X | | | | | |
| Payment Denied | | | | | X | | | | | | | | | | | | X |

Technical requirements for connecting to relational databases



- Connection to a server/resource hosting the database
 - Most common = Open Database Connectivity (ODBC)
- Secure transportation of data (encryption)
- Credentials to access the database

Demonstration

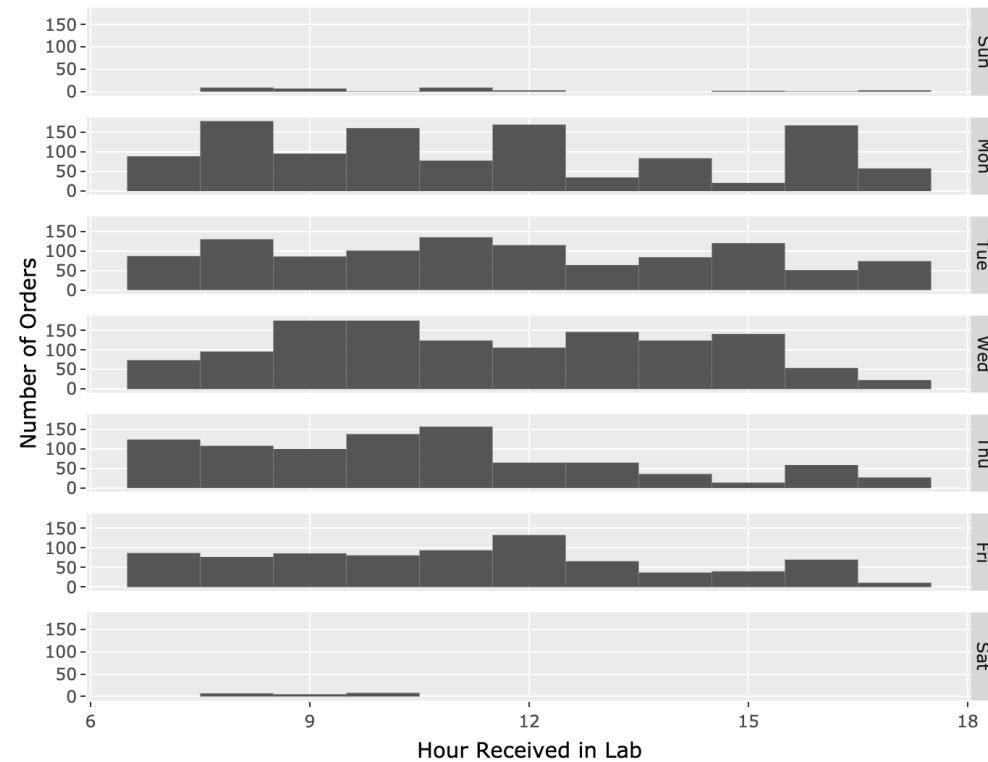
Blood Draw Time Intervals Dashboard

Last Week's Metrics

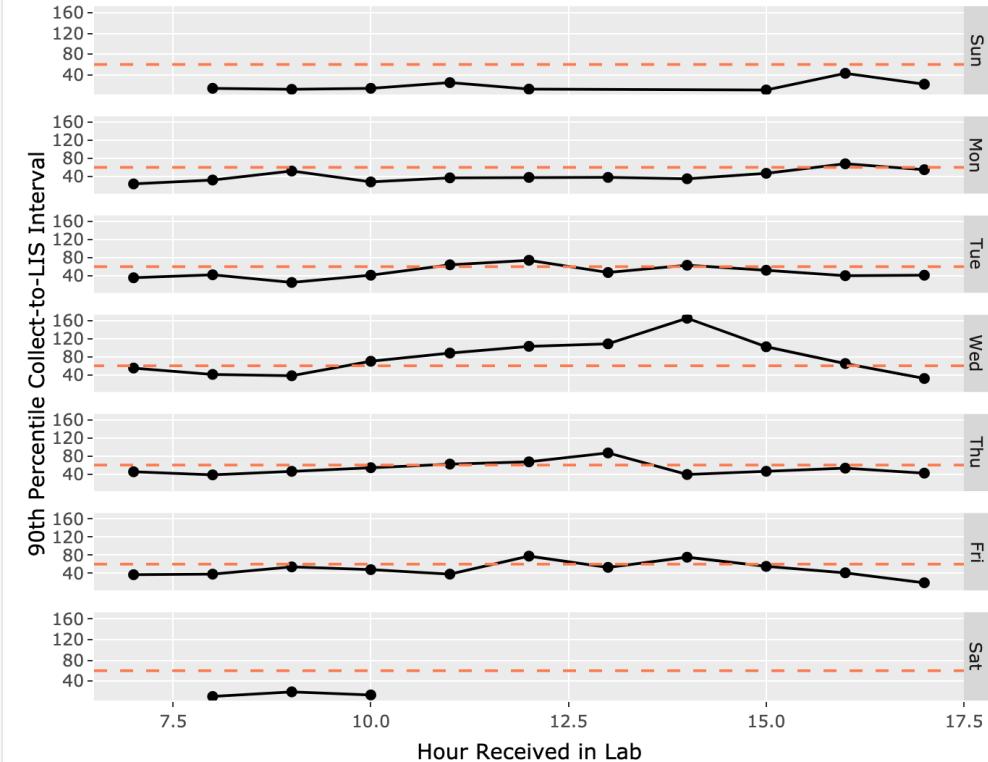
Turnaround time metrics over time

Last Week's Order Volumes by Hour

Last Week's Sample Volumes by Hour



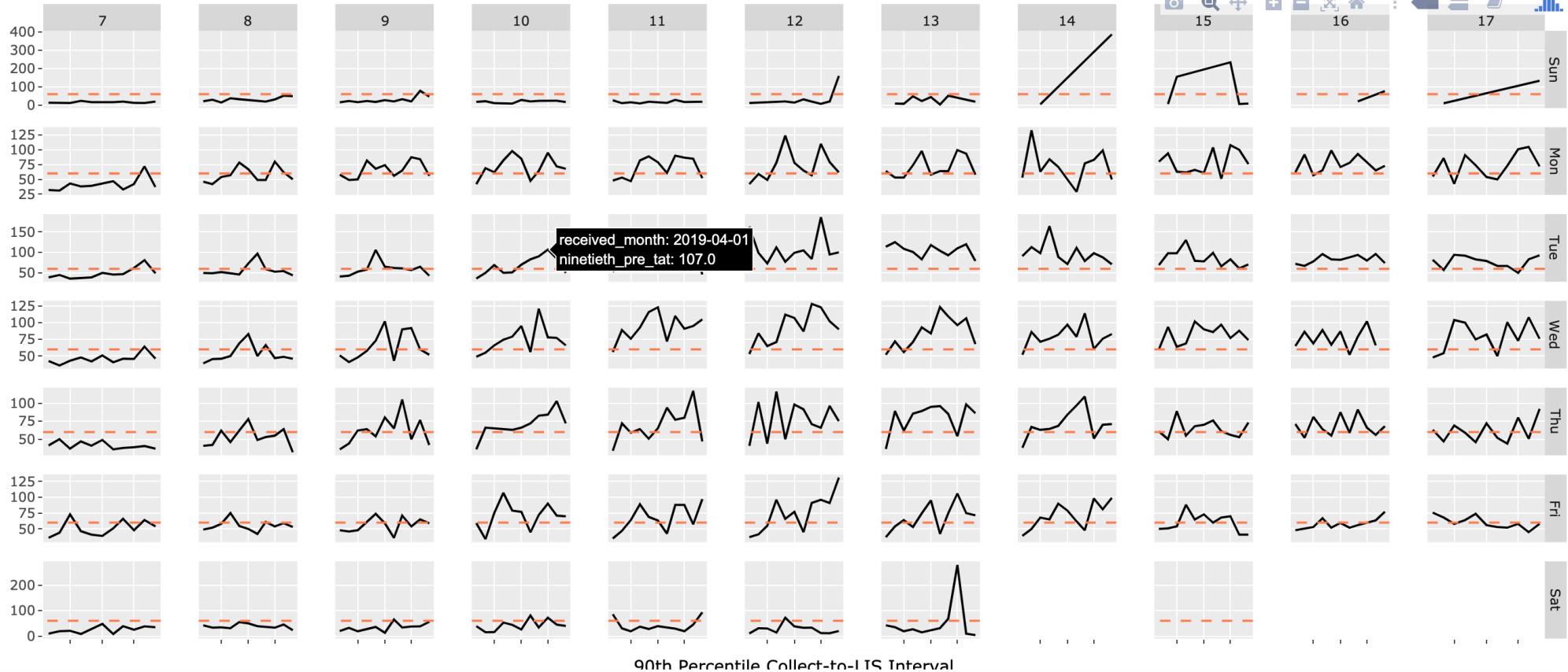
Last Week's Collection to LIS Receipt Intervals



Blood Draw Time Intervals Dashboard

Last Week's Metrics

Turnaround time metrics over time



Other options for database connections

- Keyring package (<https://github.com/r-lib/keyring>) allows you to store credentials on your operating system's credential storage scheme (Keychain for OS X or Credential Store for Windows)
 - Best for interactive work with database
- Credentials can be stored in R environment file (.Renviron)
- Prompt for credentials: `con <- DBI::dbConnect(odbc::odbc(), Driver = "impala", Host = "database.rstudio.com", UID = rstudioapi::askForPassword("Database user"), PWD = rstudioapi::askForPassword("Database password"))`
- If connection info and passwords will be stored in a file, restrict permissions to the file so that only you can access it (eg. chmod 600 filename in a Unix based system)

Automation for dashboards

- Recurring dashboards can be generated with scheduling tools
- Cron is a job scheduler for Unix based systems
- Windows Scheduler an option for Windows systems
- Rstudio Connect offers publishing and automation utilities

Alternative to the “standard” relational database systems



- Research Electronic Data CAPture is a web application developed by Vanderbilt to manage surveys
 - Can be used more broadly as a database
- `redcapAPI` is a R package that provides application programming interfaces (APIs) to underlying REDCap databases

More on connecting to databases with R tools

<https://db.rstudio.com/getting-started/connect-to-database>

Parting thoughts

- Relational databases hold large volumes of high value data at most health care systems
 - Structured query language (SQL) can help unlock this data
 - It may already be accessible by R
- Work with IT staff to understand local capabilities: many institutions are standing up analytics resources that allow R to connect with databases
- Our primary job is: do no harm
 - Always be cognizant of data security
 - Encryption! Especially when moving data

Acknowledgements

- Noah Hoffman
- Nik Krumm
- Geoff Baird
- Jim Fine
- Dave Chou
- Tuan Nguyen
- Rick Clayton
- Scott Thorson
- Jerry Davis
- Clyde Allen

QUESTIONS?

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