

Displaying Health Data

Cases, Techniques, Solutions

Colloquium + Live-Webcast + Recording
Medical Sciences Building (MBS) 160
University of Victoria
November 28 – 30 , 1 – 3 pm PST



University
of Victoria



INSTITUTE ON AGING
& LIFELONG HEALTH



island health



Displaying Health Data

Cases, Techniques, Solutions

Health Data

DAY 1

2018-11-28
Wednesday

13:00 Transactional data of Island Health: How patients vote with their feet
Dr. Ken Moselle (Island Health) and Dr. Andriy Koval (BC Observatory, UCF)

14:00 Visualizing logistic regression with the “coloring book” technique:
A study in ggplot2
Dr. Andriy Koval (BC Observatory for Population and Public Health, UCF)



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Substance Use

DAY 2

2018-11-29
Thursday

13:00 Nuances of information sharing and data display in a mobile application for students with substance use disorder
Dr. Barbara (Basia) Andraka-Christou (University of Central Florida)

14:00 Optimizing public health surveillance through reproducible reporting:
Response to opioid crisis on Vancouver Island
Shannon Tracey (University of Victoria) and Maritia Gully (Island Health)



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Pipelines & Dashboards

DAY 3

2018-11-30
Friday

13:00 Building pipelines and dashboards for practitioners: Mobilizing knowledge with reproducible reporting
Dr. Will Beasley (University of Oklahoma Health Sciences Center)



UNIVERSITY OF
CENTRAL FLORIDA

14:00 Constructing workflows for reproducible analytics: Suppressing small counts for provincial chronic disease dashboard
Dr. Andriy Koval (BC Observatory, UCF) and Anthony Leamon (Island Health)

Building pipelines and dashboards for practitioners

Knowledge mobilization with reproducible reporting



Will Beasley



Please email questions to
aging@uvic.ca

Access lecture slides from
github.com/dss-ialh/displaying-health-data

Clone the repo to reproduce examples

Building Pipelines and Dashboards for Practitioners:

Mobilizing knowledge with reproducible reporting

Will Beasley, Geneva Marshall, & David Bard
University of Oklahoma Health Science Center
Biomedical and Behavioral Health Core

Common Roles for the BBMC

domain expertise in a few areas

incorporation of data sources from multiple agencies

statistical analysis for academic publications

construct information displays for nontechnical audiences

Example 1: history of therapist training

miechv-3/eto- x | Network Graph x | Assignment Ti x | GPAV 3 Survey x | Immunization x | Negates Chara x | blucker-obesit x | TF-CBT x +

https://shiny.ouhsc.edu/TfcbtPublic/Shiny/TherapistProgress/

TF-CBT

Oklahoma TF-CBT

Filter by Agency Name(s):

Select Therapist Tag:

bm61

Filter by Call Group(s):

Select Therapist's Client:

1
1
2
3

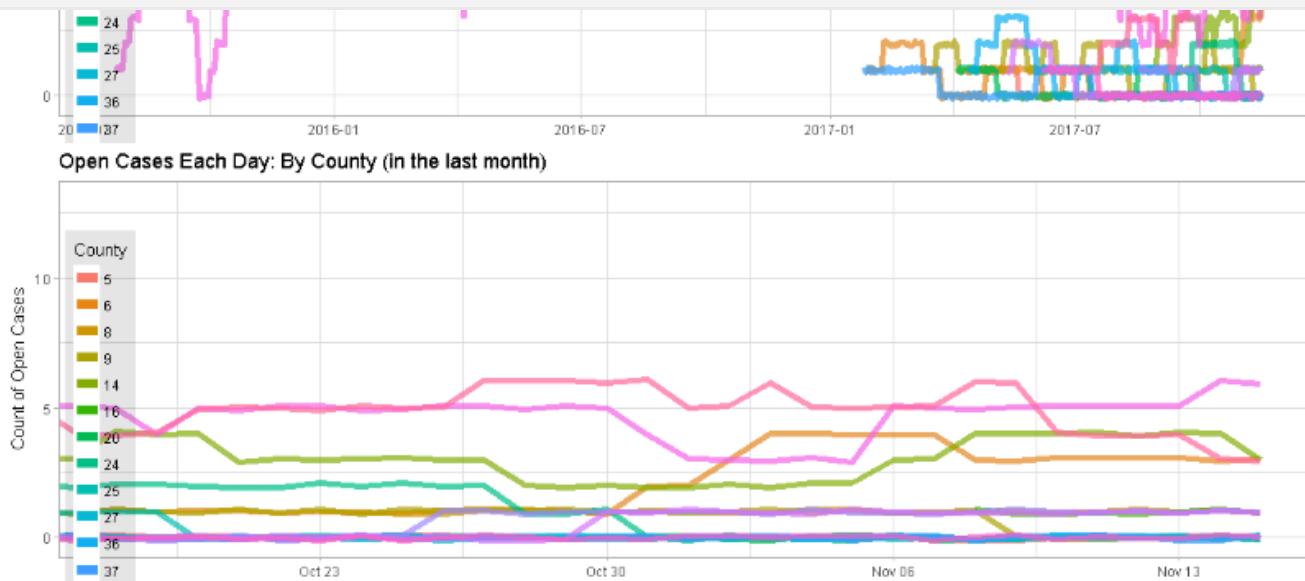
TF-CBT Session Tracking Therapist Training Trauma Symptom Tracking Details

Therapy session for the *therapist* and *client* selected above.

Session Number	01	02	03	04	05	06	07	08
Session Month	09	10	10	10	10	11	11	11
Session Day	20	01	02	25	30	08	13	20
Client Attended	Y	Y	Y	Y	Y	Y	Y	Y
PSYCHOEDUCATION: Therapist provided psycho-education (e.g., directive education about the traumatic event, normal reactions to trauma, etc.; education to instill hope)	<input type="radio"/>	<input type="radio"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
General info re: abuse, trauma; specific info re: trauma child experienced (GE) and the child's reactions to his/her personal experience of the trauma	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Common emotional, behavioral, and physiological responses.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="checkbox"/>	<input type="radio"/>				
Info about child's symptoms and diagnosis.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Description of components of TF-CBT, session structure, treatment length	<input type="radio"/>	<input type="radio"/>	<input checked="" type="checkbox"/>	<input type="radio"/>				
Engaged family (e.g., found out what child liked, what motivates the family, etc.)	<input type="radio"/>	<input checked="" type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="checkbox"/>	<input type="radio"/>
PARENTING: Therapist provided parenting skills (e.g., praise, selective attention, time out, bx mng plans); ask parent about their reactions to the child's traumatic experience	<input type="radio"/>	<input checked="" type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="checkbox"/>	<input type="radio"/>
RELAXATION: Therapist explained the physiology of relaxation and rationale for relaxation techniques; instructed on methods of relaxation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Discuss ways that relaxation skills can help child with trauma reactions (GE); suggest that child use relaxation skills when they have trauma reminders	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AFFECT REGULATION: Therapist assisted child in accurately identifying their feelings, and various ways of regulating their emotions (e.g., imagery, thought stopping, positive self-talk)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="radio"/>
Accurately identify and express a variety of feelings (positive and negative, in youth's words) (e.g. feelings brainstorm, Color My World, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="checkbox"/>	<input type="radio"/>	<input type="radio"/>
Link feelings to situations, body and facial expressions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="checkbox"/>	<input type="radio"/>
Teach how to rate intensity levels of emotions (e.g. SUDS, feeling thermometer)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="checkbox"/>
Teach skills of managing emotions and difficult affective states (e.g. positive self-talk, enhancing child's sense of safety, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="checkbox"/>

Example 2: availability of specialized CPS workers

- 1 Summary
- 2 State-level View
- 3 Supervisor-level View
- 4 County-level View
- 4.0.1 Current
- 4.0.2 Previous**
- 5 Worker-level View
- 6 Referral-level View
- 7 Session Information



5 Worker-level View

5.0.1 Current

Each row represents one ISS worker. The 'capacity by region' field squishes together the capacities for the five regions, separated by commas.

Example 3: data collection quality

3 Smells

A *smell* test won't validate a given record (like the rules above), but it will make sure the dataset overall smells correct.

3.1 Smell Summary

Smell Name	Priority	Proportion of...	Legal Boundaries	Value	Pass
female majority	1	female respondents.	[0.80, 1.00]	0.0000	FALSE
age proportion infant	2	index children under 2 months old.	[0.05, 1.00]	0.1660	TRUE
age proportion toddler	2	index children between 2 & 12 months old.	[0.20, 1.00]	0.2510	TRUE
proportion black	2	Around 4th of the survey population is black	[0.00, 0.30]	0.3166	FALSE
proportion children at home	2	Most participants have children living at home most of the time.	[0.50, 1.00]	0.8803	TRUE
proportion currently pregnant	2	More than 2/3rd of the participants are not currently pregnant.	[0.80, 1.00]	0.8672	TRUE
proportion developmental disabilities	2	Less than 10% of the children have developmental disabilities.	[0.00, 0.10]	0.0714	TRUE
proportion food stamps services	2	A little less than half the population is on food stamps.	[0.35, 0.50]	0.4981	TRUE
proportion hispanic	2	A little less than half the survey population is Hispanic.	[0.30, 0.40]	0.2857	FALSE
proportion household children	2	Around half of our survey population has households with one child.	[0.40, 0.50]	0.4942	TRUE

GPAV 3 Survey Validation

Date: 2018-11-06 10:46:50

This report identifies violations in the [GPAV 3 Community Survey](#) dataset, aka (Giving Parents A Voice -MIECHV 3).

1 Set Up

[1.1 Instructions](#) [1.2 Execute Rules](#) [1.3 Execute Smells](#) [1.4 Inactive Rules](#) [1.5 Inactive Smells](#)

1. Work through each line in the table to discover & correct entry mistakes in the database. Be aware that a single mistake may manifest in multiple rows; fixing one value may clear several rows.
2. Click the `record id` value in a row to be taken to the participant's Event Grid in REDCap (i.e., the 'stop light page').
3. Double-check that your manual corrections in REDCap are reflected in `data-public/derived/gpav/gpav-3-violation-rule.csv`. Be careful not to move this file to somewhere unsafe.
4. To help discover the dataflow and problematic location, use the
 - project's [codebook](#) in REDCap,
 - [gpav-3-arch](#) file, and
 - [validation-gpav-3](#) report.
5. If you create a new rule or smell check, make sure the error message won't reveal any PHI.

2 Rules

A *rule* is very exact. Each record is examined, and determined if it passes each specific rule.

[2.1 Rule Detail](#) [2.2 Rule Summary](#)

Violations at 2018-11-06 10:47:04

check name	record id	data collector	error message	priority	instrument	interview date	
		.	All		AI	A	
1	parent pro services	255-24	8	ParentPRO home-based services status is missing. (The question is 'Are you currently participating in parentPRO home-based services?')	1	participant demographics	2018-09-05
2	parent pro services	255-63	8	ParentPRO home-based services status is missing. (The question is 'Are you currently participating in parentPRO home-based services?')	1	participant demographics	2018-10-09
3	Parentpro service	255-24	8	ParentPRO service status is missing when recruit source is present. If recruit source	1	participant	2018-09-05

Example 4: MCMC HPDs are updated as collection progresses

1. Histogram Overlay

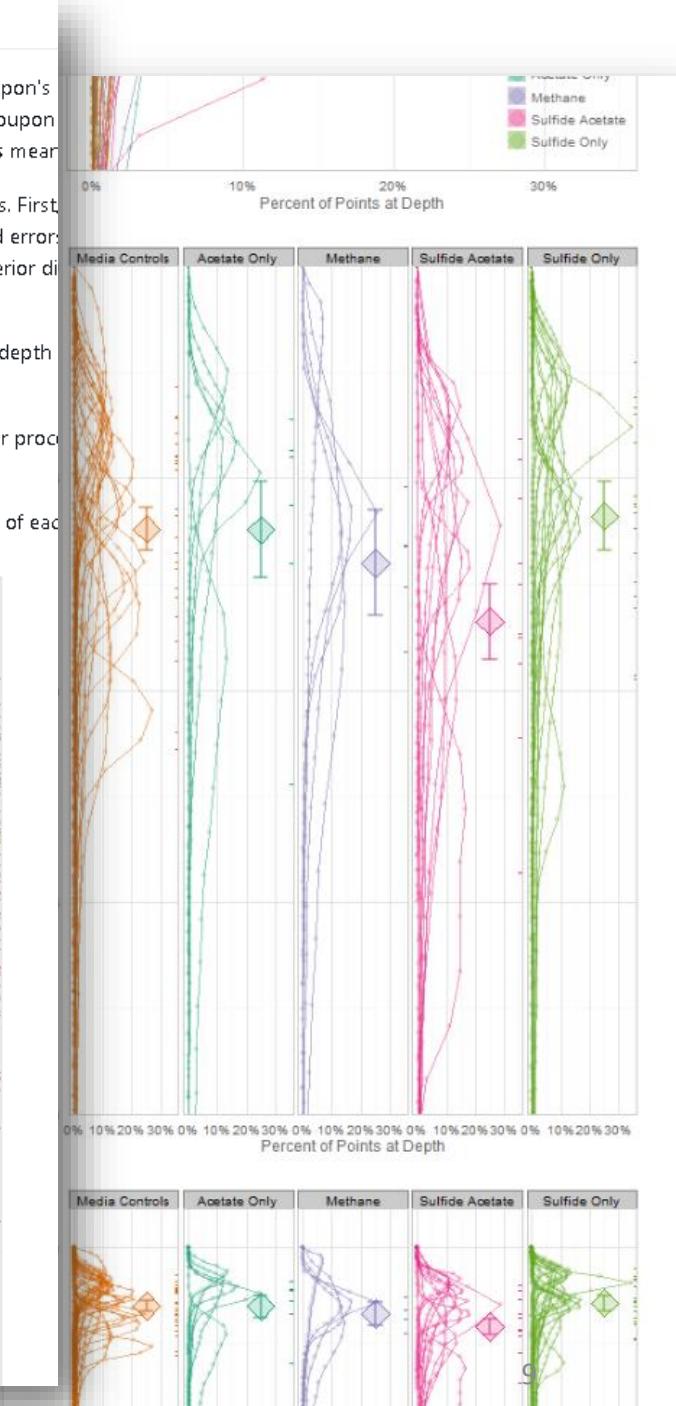
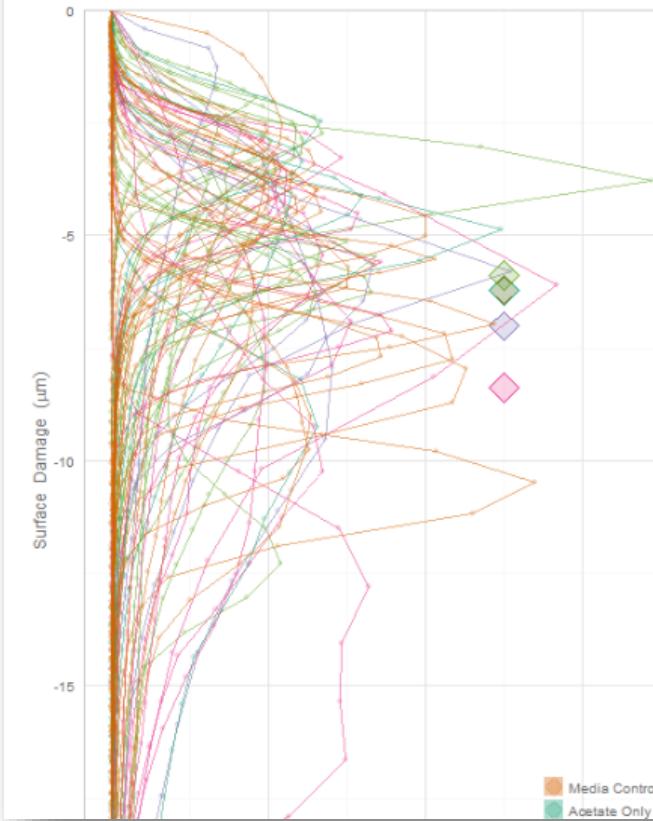
The **first graph** represents the probe heights, as a distance from the coupon's value is the depth of the probe, while the x indicates how much of the coupon treatment's mean depth. The ticks on the right side indicate a coupon's mean

The **second graph** is almost identical to the first, but with two differences. First, standard errors are shown around each treatment mean; the means and error bars are shown below. They bands mark the 16% and 84% quantiles of the posterior distribution. The 68% coverage of a ± 1 parametric SE band.

The **third graph** is identical, yet loosens the y -axis range so that the full depth maximum pit depth is a variable worth including in a formal analysis.

The five outlier coupons are *excluded* from these two graphs (ie, the four process coupons and one suspicious control coupon).

The diamonds/means for `AcetateOnly` and `MediaControls` are on top of each other.

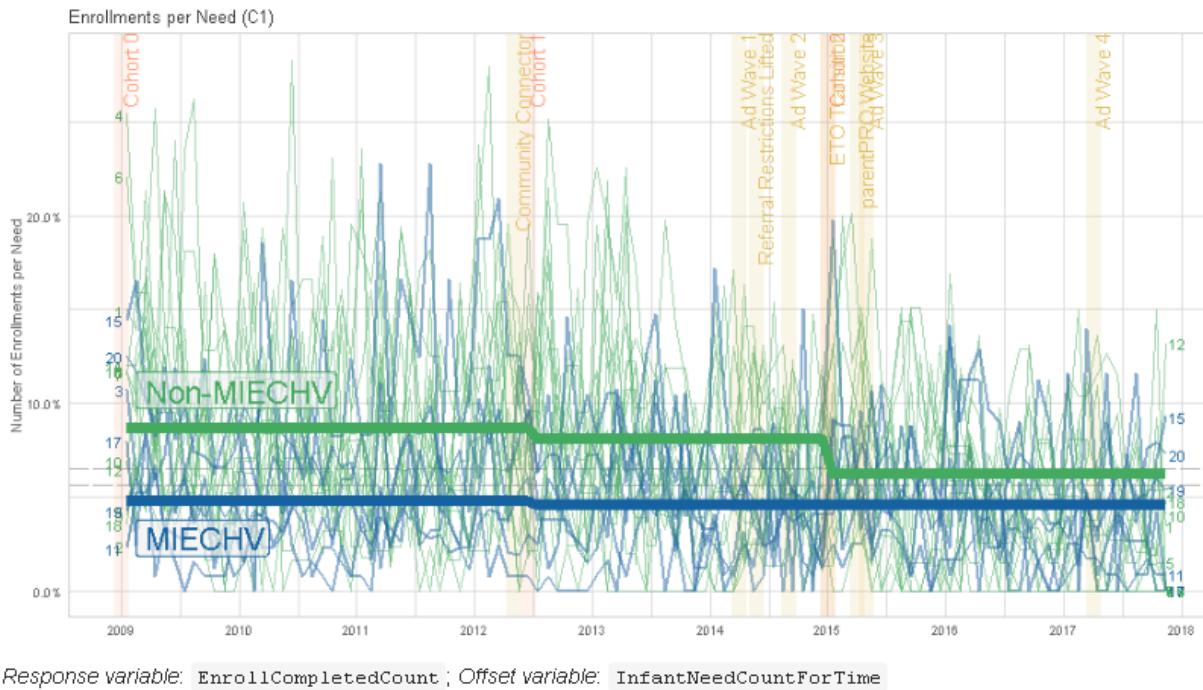


Example 5: semi-annual reports with multilevel longitudinal models

completed enrollments (not significant for the drop between 0 and 1, but significant for the drop between 0 and 2. Coefficients $1d$ and $1e$ are greater than 1.00, but not significant; a significant coefficient would have indicated that the six MIECHV regions are comparatively outgaining the fourteen comparison regions between cohorts 0 and 2. However, $1b \times 1d$ produces a value under 1.00 (and $1c \times 1e$ do too), indicating MIECHV regions observed a decline in overall enrollments (but a much less steep decline than comparison regions). This pattern is evident in Figure zzz; notice how the green line descends sharply during the nine year period, while the blue line is essentially flat. The groups' enrollment rates are almost equal by 2015.

The estimates from Models 2 and 3 corresponded closely to Model 1, suggesting that the three operationalizations of the MIECHV treatment are comparable for completed enrollments. The only notable difference involves coefficient g . The Model 2 and 3 estimates are about 5%, at which point coefficients become significant; this suggests MIECHV regions did relatively better than non-MIECHV regions between cohorts 1 and 2.

	MIECHV Contracted		MIECHV Staffed		Has Connector	
	Change	p	Change	p	Change	p
0 - NvM :	1a	0.57 <.001	2a	0.62 <.001	3a	0.68 <.001
Ov1 - N :	1b	.93 .235	2b	0.94 .181	3b	0.97 .533
Ov2 - N :	1c	0.71 <.001	2c	0.76 <.001	3c	0.76 <.001
Ov1 - NvM :	1d	1.01 .925	2d	1.00 .978	3d	0.89 .088
Ov2 - NvM :	1e	1.29 .103	2e	1.17 .003	3e	1.18 .002
1v2 - N :	1f	1.05 .287	2f	0.99 .744	3f	0.96 .276
1v2 - NvM :	1g	1.23 <.001	2g	1.26 <.001	3g	1.31 <.001



dashboards vs reports

- Blur the distinction
- Try to make your reports more like dashboards, so they
 1. Are automated,
 2. Are frequently updated & consumed (especially early in the project),
 3. Actively flag errors, and
 4. Are easy and fun to jump into
- Try to make your dashboards more like reports, so they
 1. Provide context and are self-explanatory,
 2. Are portable and archivable, and
 3. Contain statistical analyses that encourage sophisticated reasoning.

<input type="checkbox"/> Name
<input checked="" type="checkbox"/>  analysis
 data-public
 data-unshared
 documentation
 libs
 manipulation
 sandbox
 scripts
 stitched-output
 utility
 .gitattributes
 .gitignore
 .Rbuildignore
 config.yml
 DESCRIPTION
 displaying-health-data
 LICENSE
 NEWS
 README.md

<input type="checkbox"/> Name
 alluvia-1
 common
<input checked="" type="checkbox"/>  dashboard-1
 report-1
 report-te-1
 trajectory-1
 venn-1
 README.md

<input type="checkbox"/> Name	Type
 figure-dashboard-png	File folder
<input checked="" type="checkbox"/>  dashboard-1	Chrome HTML Document
 dashboard-1	R File
 dashboard-1	RMD File
 README.md	MD File

Fictional,
Reproducible
example

github.com/dss-ialh/displaying-health-data

Pipeline (available at github.com/dss-ialh/displaying-health-data)

Raw CSVs

The external data's first appearance in our system.

`~data-public/raw/``

Central Database

The inspected & loaded data into tables.

`~data-public/derived/``

Analysis-Ready Rectangles

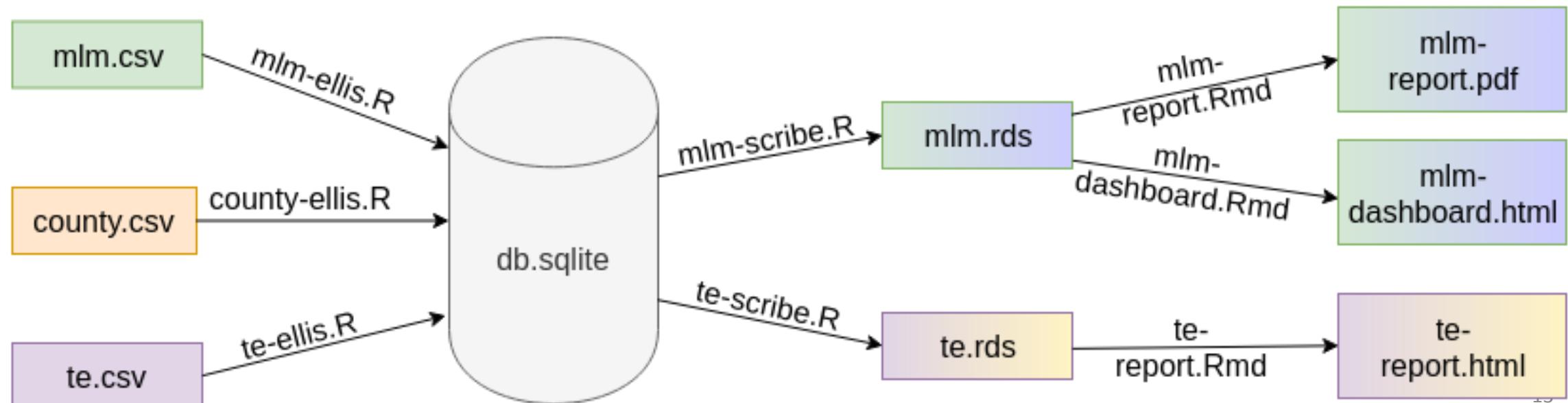
The joined & groomed datasets easily digestible.

`~data-public/derived/``

Analysis

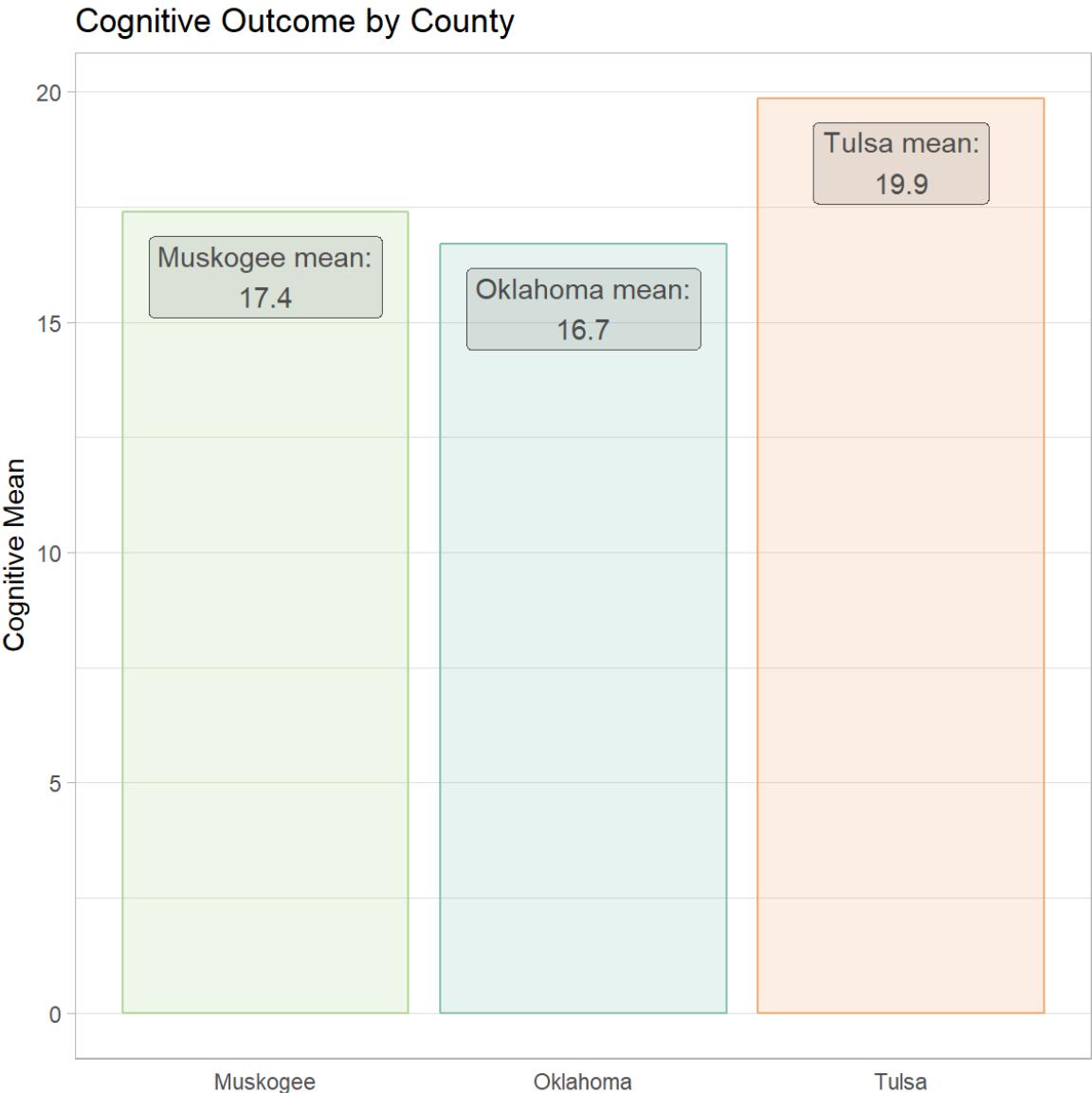
Products for internal & external audiences,

`~analysis/``



Fictional scenario

- We partner with the government to monitor the cognitive trajectories of patients over time.
- Recruited 200 seniors from three county programs.
- Dashboard is tailored to providers in Tulsa



In the real study...

The nurses create three 6-month mini-research studies.

They develop a manageable change to the services they provide, and see if their mini-intervention improves an outcome they've chosen.

One real intervention developed a thorough script of welcoming new clients. A second intervention was sending text messages to clients to reduce no-shows. A third intervention developed guidelines for discussing traumatic ACEs in their past.

Starts with 2-day workshop to develop the ideas.

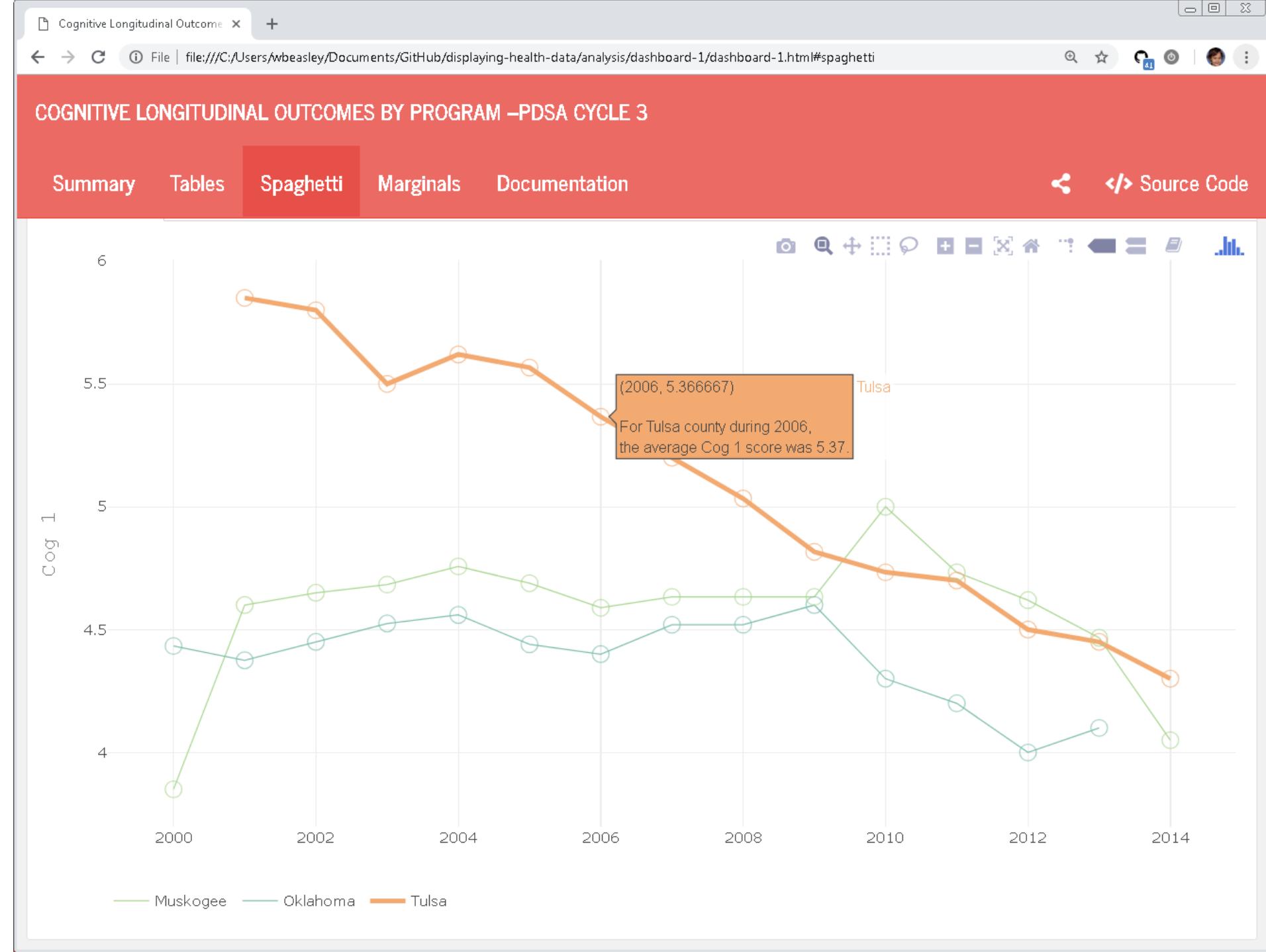
Data Glimpse

(start demo)

```
> ds %>% dplyr::glimpse(50)
Observations: 200
Variables: 21
$ subject_wave_id <int> 1, 2, 3, 4, 5, 6, 7, ...
$ subject_id       <int> 1001, 1001, 1001, 100...
$ county_id        <int> 51, 51, 51, 51, 51, 5...
$ gender_id        <dbl> 2, 2, 2, 2, 2, 2, 2, ...
$ race              <chr> "Native Hawaiian or O...
$ ethnicity        <chr> "Hispanic or Latino",...
$ county            <chr> "Muskogee", "Muskogee...
$ wave_id           <int> 1, 2, 3, 4, 5, 6, 7, ...
$ year              <int> 2000, 2001, 2002, 200...
$ date_at_visit    <date> 2000-04-25, 2001-02-...
$ age               <int> 67, 68, 69, 70, 71, 7...
$ age_cut_4         <chr> "60s", "60s", "60s", ...
$ age_80_plus        <int> 0, 0, 0, 0, 0, 0, 0, ...
$ int_factor_1      <dbl> 8.895, 8.895, 8.895, ...
$ slope_factor_1    <dbl> -0.029, -0.029, -0.02...
$ cog_1              <dbl> 3.3, 3.5, 3.5, 3.4, 3...
$ cog_2              <dbl> 4.6, 4.6, 4.2, 4.7, 4...
$ cog_3              <dbl> 5.3, 5.3, 5.2, 5.2, 5...
$ phys_1             <dbl> 2.8, 2.9, 2.8, 3.1, 3...
$ phys_2             <dbl> 3.9, 3.5, 3.9, 3.9, 3...
$ phys_3             <dbl> 0.5, 0.0, 0.7, 1.3, 2...
```

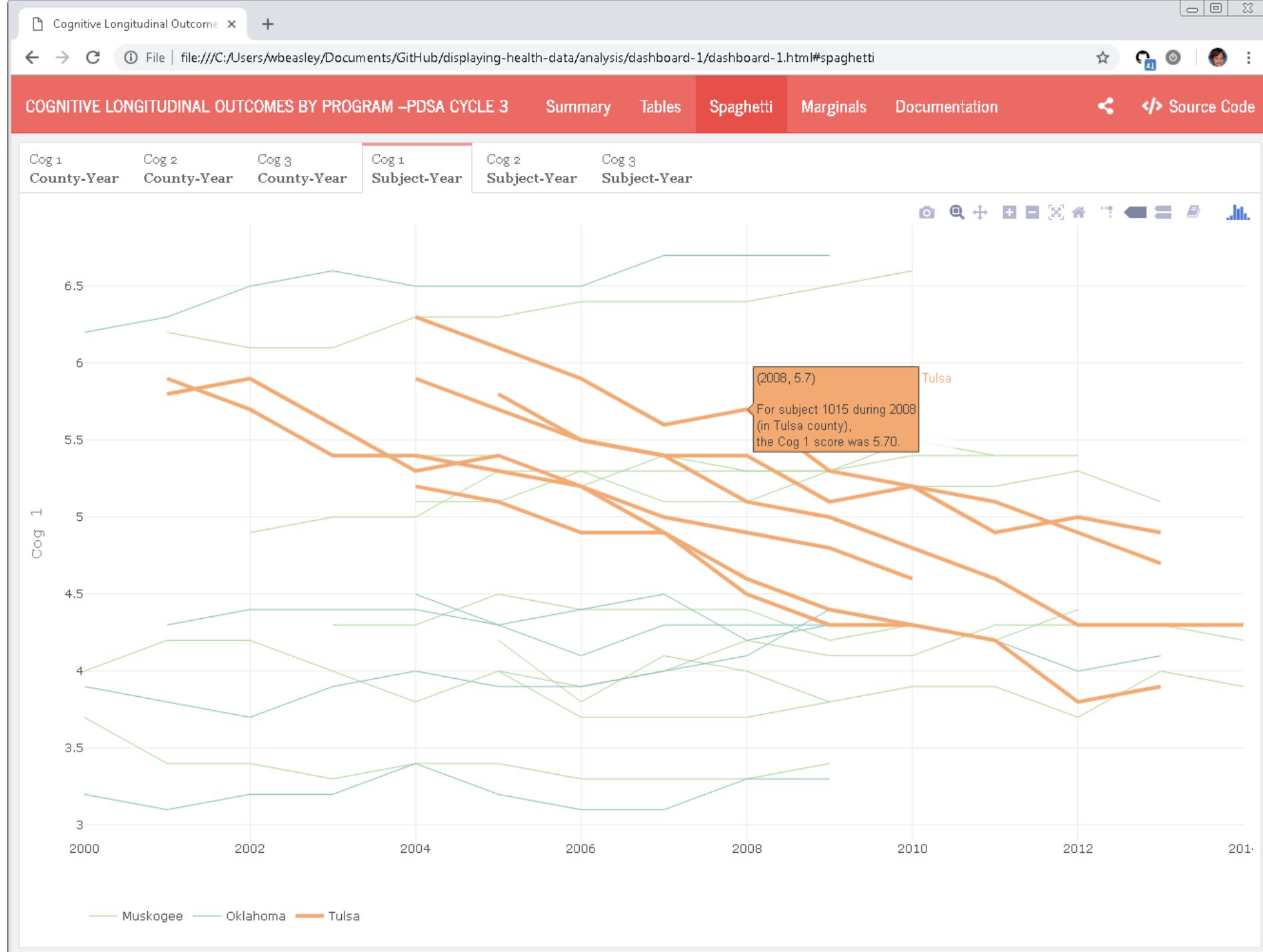
Program directors
need to monitor the
focal group over
time.

De-emphasized
programs provide
meaningful
reference points.



We also need to see the progress of individuals

Tulsa county trajectories are in orange. The others are primarily for context.



Some nurses were more comfortable starting with tables than graphs.

Cognitive Longitudinal Outcome

COGNITIVE LONGITUDINAL OUTCOMES BY PROGRAM –PDSA CYCLE 3

Summary Tables Spaghetti Marginals Documentation

Show 16 entries Search:

	county	year	cog 1 mean	cog 2 mean	cog 3 mean	phys 1 mean	phys 2 mean	phys 3 mean
1	Muskogee	2014	4.0	5.0	6.2	3.1	3.8	1.3
2	Tulsa	2014	4.3	5.9	7.2	4.0	5.1	1.2
3	Muskogee	2013	4.5	5.7	6.7	3.3	4.1	1.5
4	Oklahoma	2013	4.1	5.1	6.5	3.4	4.5	0.2
5	Tulsa	2013	4.5	6.0	7.4	3.6	4.6	2.0
6	Muskogee	2012	4.6	5.9	6.9	3.2	4.0	1.9
7	Oklahoma	2012	4.0	5.0	6.4	3.1	4.0	1.4
8	Tulsa	2012	4.5	6.1	7.5	3.7	4.7	1.7
9	Muskogee	2011	4.7	5.9	7.0	3.3	4.0	1.8
10	Oklahoma	2011	4.2	5.0	6.2	3.1	4.4	1.7

Showing 1 to 16 of 43 entries

Previous 1 2 3 Next

Histograms are particularly benefited from full-sentence hover text.



Each dashboard had several tabs of documentation.

Our quality varied across dashboards, and this is a representative example.

COGNITIVE LONGITUDINAL OUTCOMES BY PROGRAM –PDSA CYCLE 3 [Summary](#) [Tables](#) [Spaghetti](#) [Marginals](#) [Documentation](#)

[Explanation -Current PDSA](#) [Explanation -All CQI Dashboards](#) [Glossary](#) [Tips](#) [Config](#)

SMART Aim

By implementing plans for self-care activities with established clients, primary caregivers will see a mean score reduction of at least 4 points on the Parenting care activities by 12-1-18.

Measures

- **Outcome:** Parent Stress
 - Pre- and Post- Parent Stress Scale score change
- **Process:** Completed Resiliency Plans
 - *Numerator:* Count of clients who completed their designated self-care activity
 - *Denominator:* Count of clients with a visit in a given week
- **Disruptor:** Cultural issues preventing participation, toxic stress, family catastrophe

Spaghetti Notes

- **To be added:**
 - Post score plots
 - Pre-post comparisons
 - Splitting out new clients from old clients to see if differences are more or less prominent
- **Mean PSS Scores - Pre:**
 - Each blue dot represents a single client's PSS score on the pre measure
 - The orange dots (connected by the red line) represent the mean PSS score for all clients on a given week.
 - Dot size is proportional to the number of clients who had a pre-PSS score.
- **Stress Activity - Success:**
 - *Numerator:* Number of clients who indicated having completed their self-care activity
 - *Denominator:* All clients who responded to the self-care question (Yes/No to self-care)
 - *Dot size:* The dot size is proportional to the number of clients who responded to that question on a given week.

Resources

- [Current PDSA](#)

Lessons Reinforced

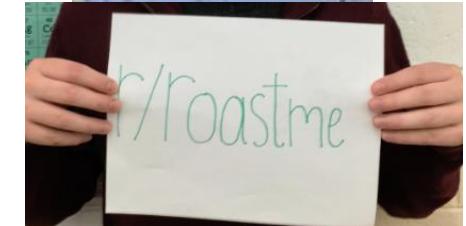
1. The providers have incredible ideas for improving services delivered. It's worth our time to facilitate and translate these ideas.
2. Implementing their tx & measurements ideas increases their engagement.
3. Incorporate the providers in the dashboard design
4. Math phobia is real, and it might be hard for your developers to relate to.
5. Writing the scribes is difficult (ie, grooms and reshapes multiple analysis-agnostic data tables into a single analysis-specific rectangle).

Lessons Learned

1. This particular group of nurses preferred a top-down entry into their data. Most scientists prefer bottom-up. Here are some examples of how we changed our presentation.
2. Hovering text provides an alternative entry into understanding the graph.
3. Incorporate the providers in the dashboard design
4. Monthly meetings are not frequent enough at the beginning

Suggestions for dashboard improvements?

- Specific graphs
- Presentation order
- Verbal documentation
- My approach/attitude towards the information
- My approach/attitude towards the consumers
- Feature to emphasize or de-emphasize



Pipeline (available at github.com/dss-ialh/displaying-health-data)

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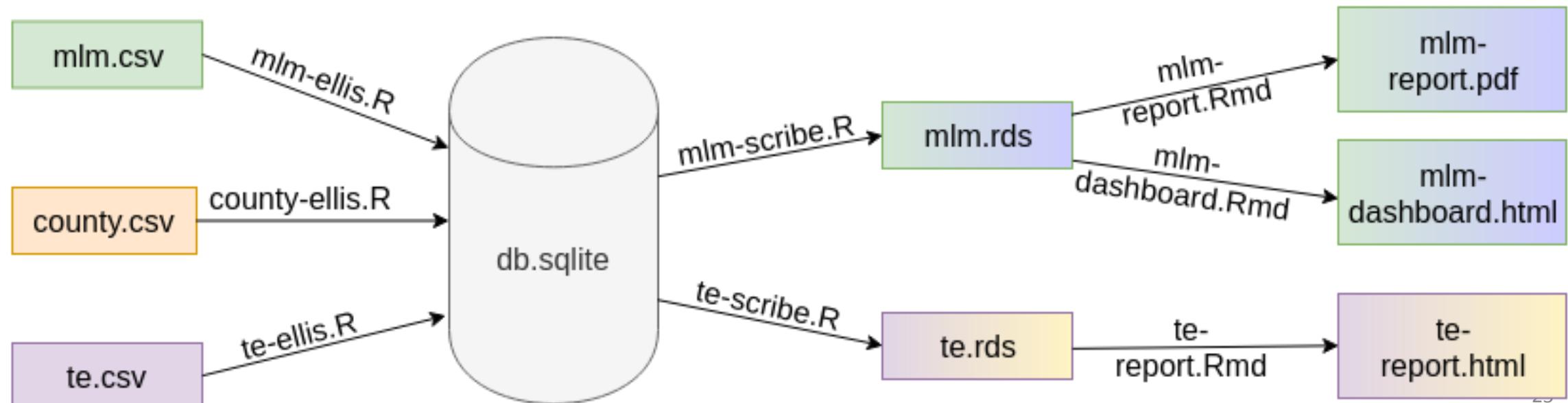
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Analysis

Products for internal & external audiences,

`~analysis/``



Pipeline

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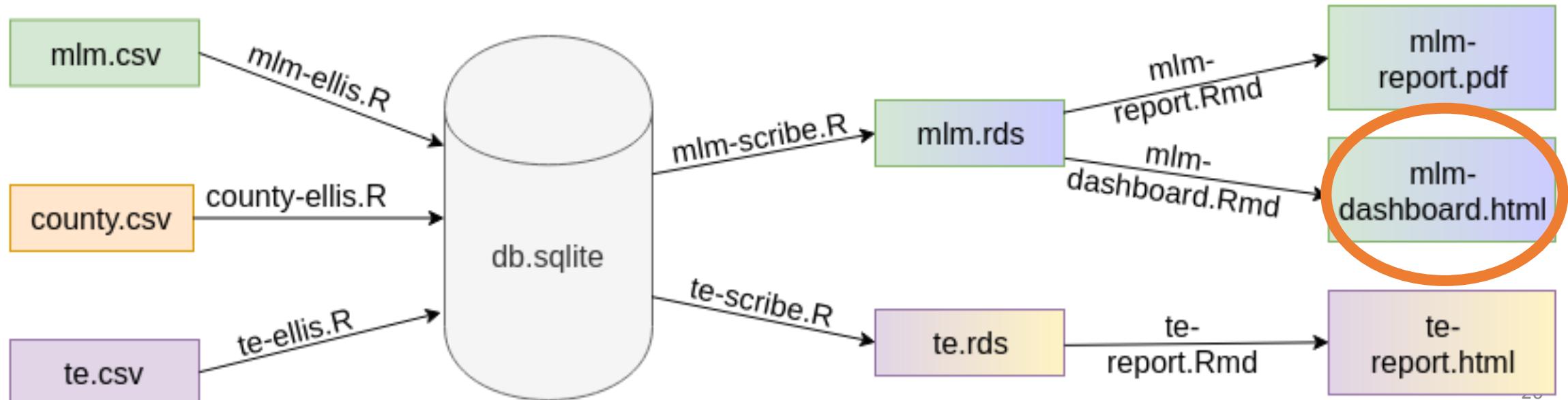
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`~analysis/``



Benefits

1. Scaling

1. more data sources
2. multiple analysts
3. multiple reports

2. Hide PHI for as long as possible

3. Leverage database performance

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Analysis-Ready Rectangles

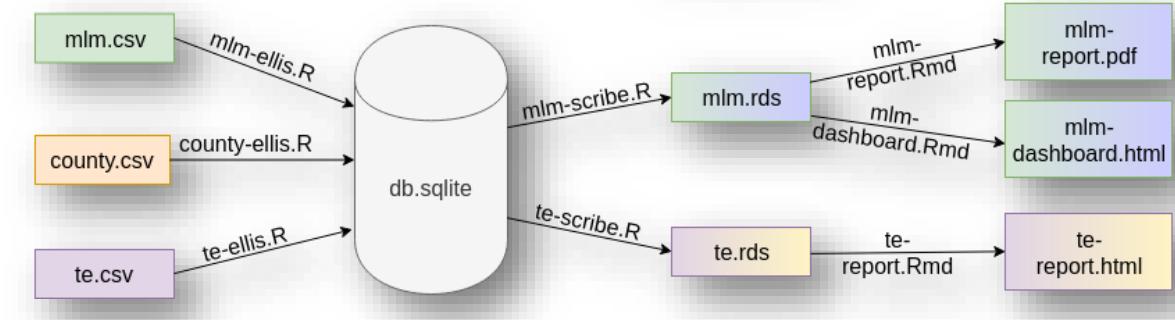
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`data-public/derived/`

Analysis

Products for internal & external audiences,

`analysis/`



Deployment Options

1. Server-rendered vs Client-rendered

2. Interactive vs static

3. Stage to redact PHI

4. Reconnect to PHI record using authentication

5. human vs cronjob

2.1 Rule Detail							2.2 Rule Summary	
Violations at 2018-11-06 10:47:04								
check name	record id	data collector	error message	priority	instrument	status	count	last modified
1 parent pro services	255-24	8	ParentPRO home-based services status is missing. (The question is 'Are you currently participating in parentPRO home-based services?')	1	participant demographic	OK	1	2018-11-06 10:47:04
2 parent pro services	255-63	8	ParentPRO home-based services status is missing. (The question is 'Are you currently participating in parentPRO home-based services?')	1	participant demographic	OK	1	2018-11-06 10:47:04
3 Parentpro service recruit source	255-24	8	ParentPRO service status is missing when recruit source is present. If recruit source is present then parent pro service status	1	participant demographic	OK	1	2018-11-06 10:47:04

Providers in Oklahoma

1. **Oklahoma State Department of Health**– Persephone Starks, John Delara, Beth Martin
2. **Children First Tulsa** – LouAnn Beuke
3. **LCDA** – Patty Demoraes-Huffhine
4. **Oklahoma City County Health Department** – Denise Howard, Diane Sammons, Sally Dixon
5. **OKC Public Schools** – Yolanda Lucero, Kethzia Njikam
6. **PAT Bethany Public Schools** – Mindy Turner, Jem Balderas
7. **PAT Parent Promise** – Shawna Norman
8. **Community Action Program Tulsa** – Dana James
9. **Cherokee PARENTS** – Ben King, Jennifer Kirby, Amy Thilges
10. **PCCT PAT Tulsa** - Sarah Neyman
11. **SafeCare PCCT** – Sheri Davis
12. **SafeCare NorthCare** – Dwan McDonald

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