

Interactive Analytics and Automated Report Generation in Public Health

PhUSE SDE Mississauga 2019

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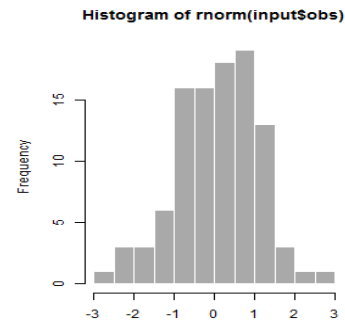
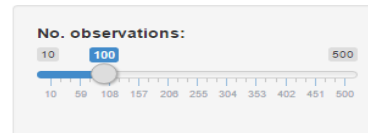
matt-kumar.shinyapps.io/portfolio

Overview

1. Introduction
2. Interactivity
3. Applications of Interactivity in Public Health
4. Questions

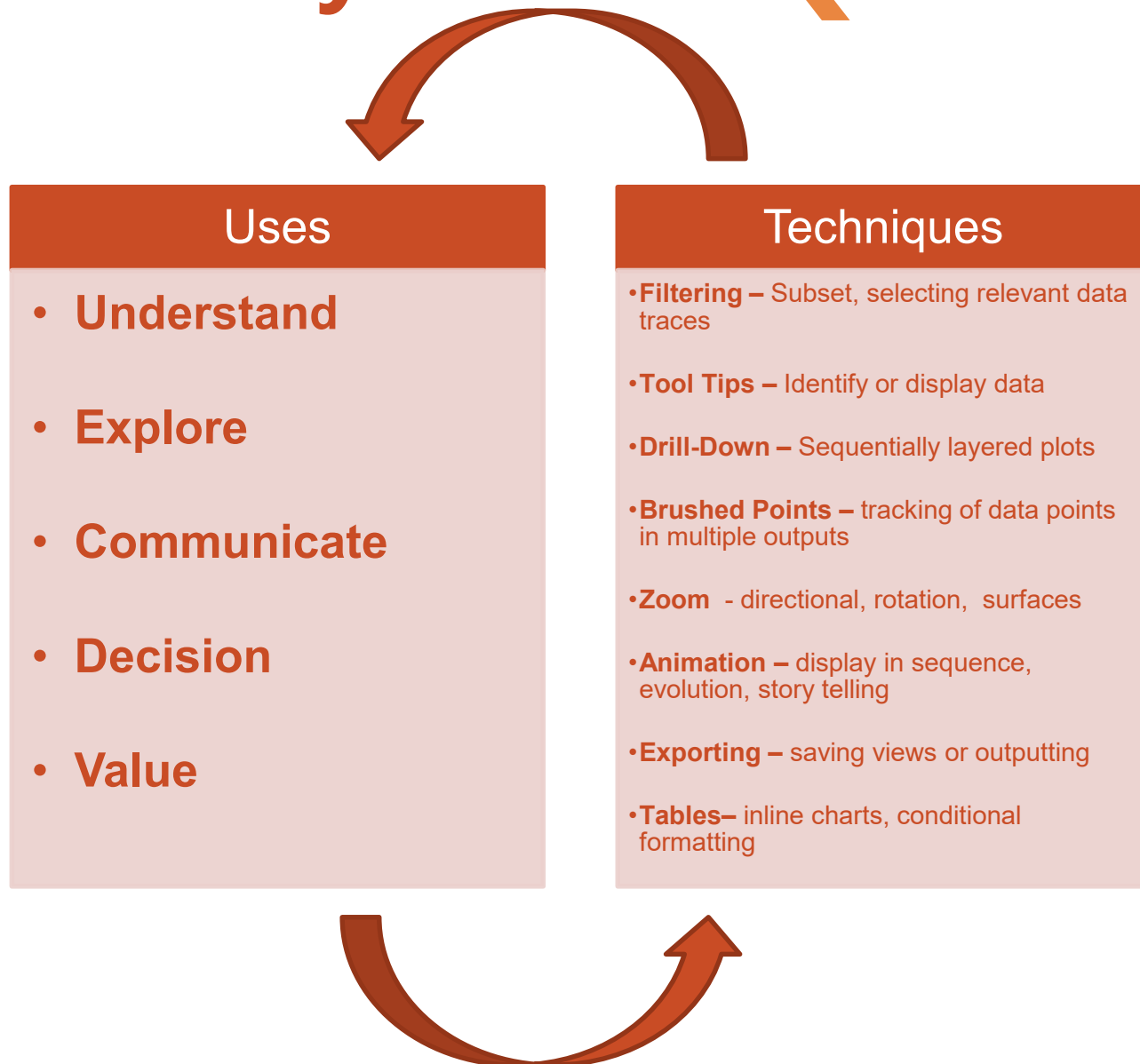
Introduction

- R-Shiny
 - An open source framework for developing web apps in R
 - Reactive Programming- *'change input, observe result'*

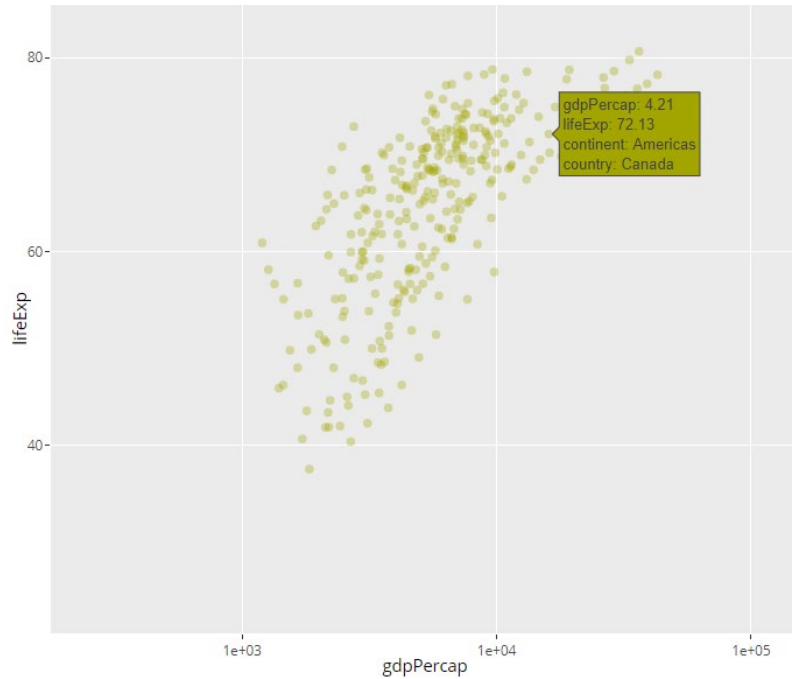


- Transform R programming, analyses and data visualizations into interactive webpages that anyone can use.
- R-Shiny apps as 'pre-packaged analyses' and as 'general purpose tools'

Interactivity



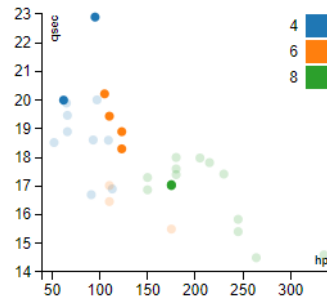
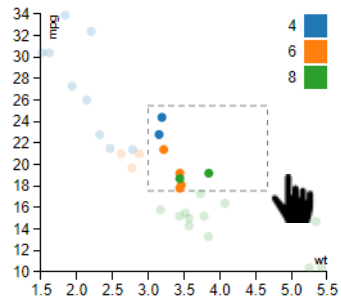
Interactivity



Tool Tips, Filtering

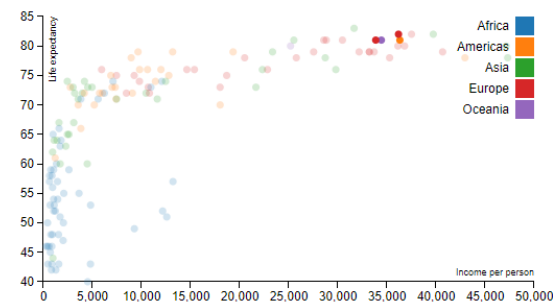
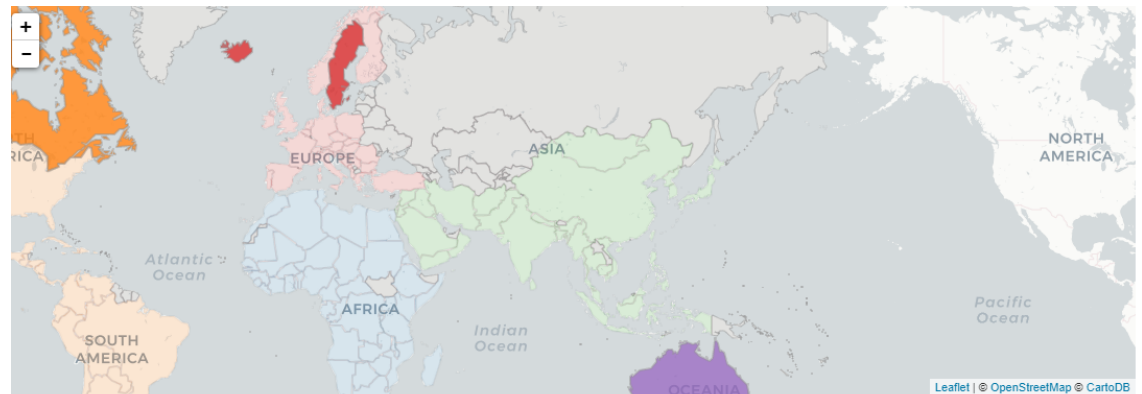


Interactivity



Brushed Points

Brushed Points across different outputs

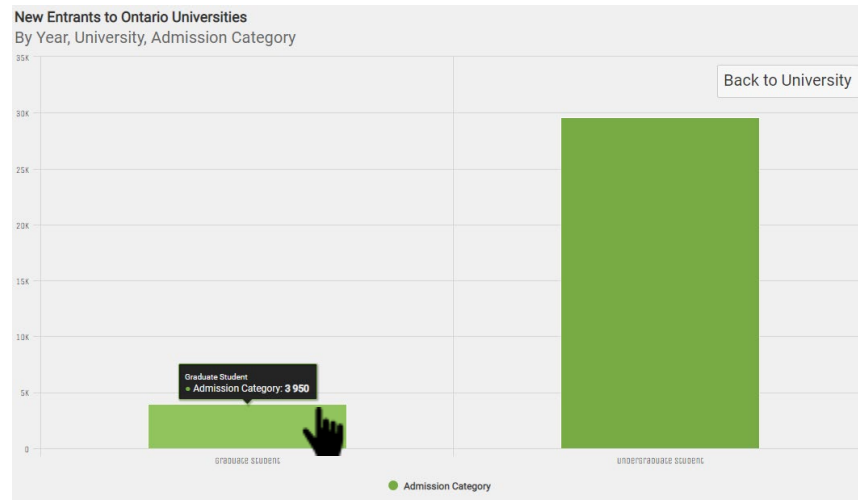
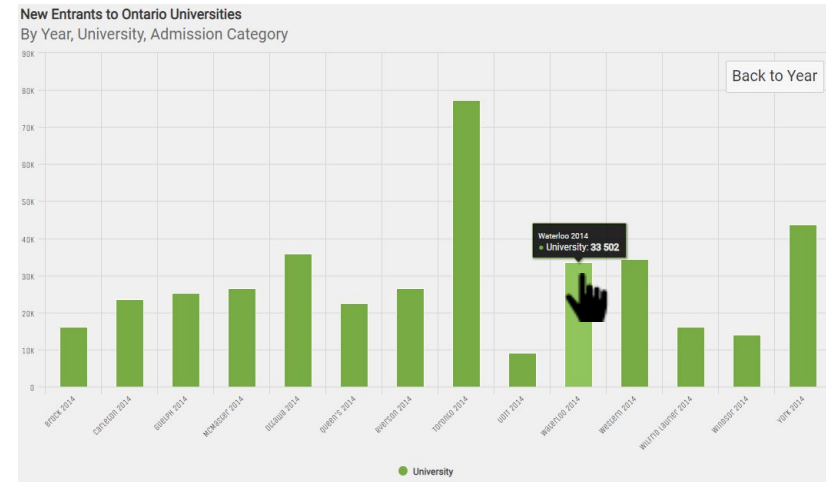
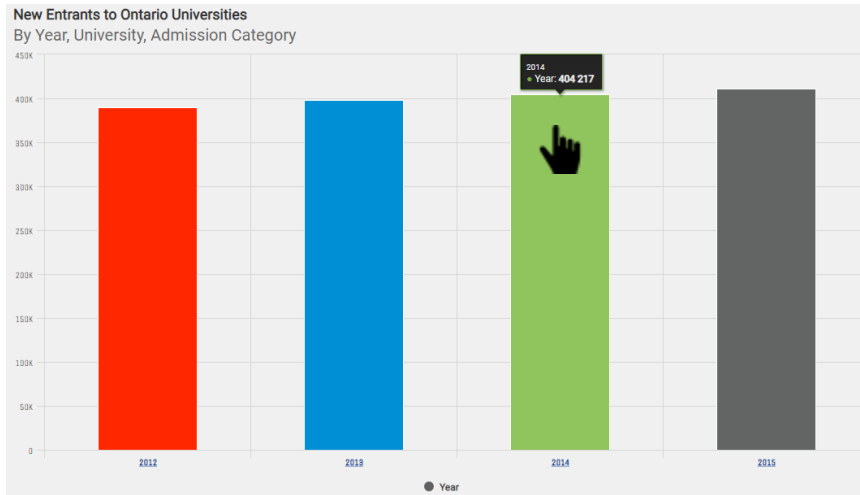


Search:

country	continent	year	lifeExp	pop	gdpPrp
Australia	Oceania	2007	81	20434176	34435
Canada	Americas	2007	81	33390141	36319
Iceland	Europe	2007	82	301931	36181
Sweden	Europe	2007	81	9031088	33860

Showing 1 to 4 of 4 entries (filtered from 141 total entries)

Interactivity



Drill-Down, Tool Tips

Interactivity

Show entriesSearch:

Location	Month	Var	Decade	Mean	SD	Min	Max	Series	Series
Edmonton, Alberta	Aug	Temperature	1950s	14.8	1.2	13.1	17		
Edmonton, Alberta	Aug	Temperature	1960s	15.7	1.61	13	18.2		
Edmonton, Alberta	Aug	Temperature	1970s	15.2	1.82	12.4	17.9		
Edmonton, Alberta	Aug	Temperature	1980s	15.5	2.03	13	18.8		
Edmonton, Alberta	Aug	Temperature	1990s	16	1.64	13.1	18.5		
Edmonton, Alberta	Aug	Temperature	2000s	15.3	1.22	14	17.3		

Lower Quartile: 14.6
 Median: 16.25
 Upper Quartile: 17.3
 Left Outlier: 13.1
 Right Outlier: 18.5
 Left Whisker: 13.1
 Right Whisker: 18.5

Type	Sparkline
bar	
line	
bullet	
pie	
tristate	
discrete	

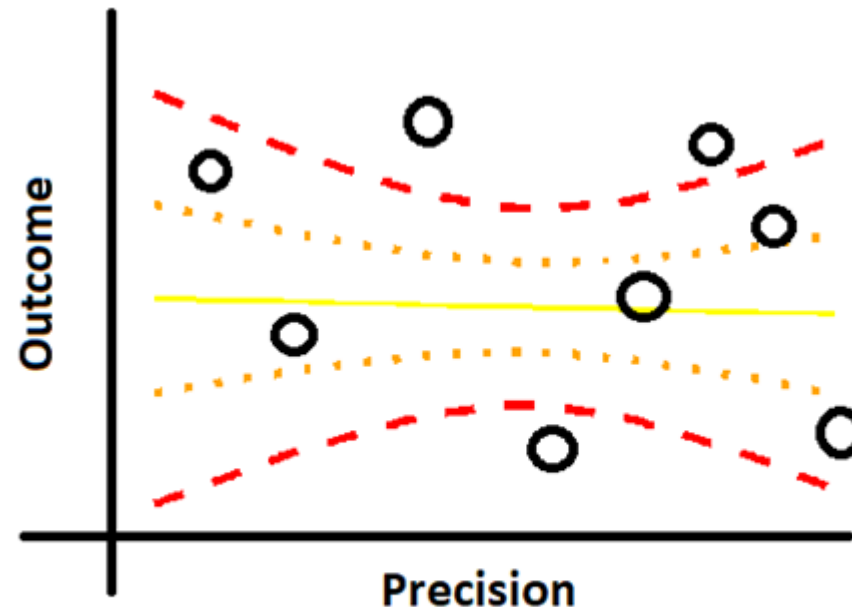
Spark Line, Tool Tips

Conditional formatting in tables or listings

id	name	age	grade	test1_score	test2_score	final_score	registered
1	Bob	28	C	8.9	9.1	9.00 (rank: 06)	✓ Yes
2	Ashley	27	A	9.5	9.1	9.30 (rank: 03)	✗ No
3	James	30	A	9.6	9.2	9.40 (rank: 02)	✓ Yes
4	David	28	C	8.9	9.1	9.00 (rank: 06)	✗ No
5	Jenny	29	B	9.1	8.9	9.00 (rank: 06)	✓ Yes
6	Hans	29	B	9.3	8.5	8.90 (rank: 08)	✓ Yes
7	Leo	27	B	9.3	9.2	9.25 (rank: 04)	✓ Yes
8	John	27	A	9.9	9.3	9.60 (rank: 01)	✗ No
9	Emily	31	C	8.5	9.1	8.80 (rank: 09)	✗ No
10	Lee	30	C	8.6	8.8	8.70 (rank: 10)	✗ No

Case 1: Funnel Plots

- Analysis of unit level performance relative to some benchmark
- A scatterplot of an **outcome** against a measure of its **precision**
- Thresholds drawn typically at ± 2 Standard Deviations ($\sim 95\%$)
- Answers: Which units exhibit extreme values or behavior? Which units operate within acceptable limits?

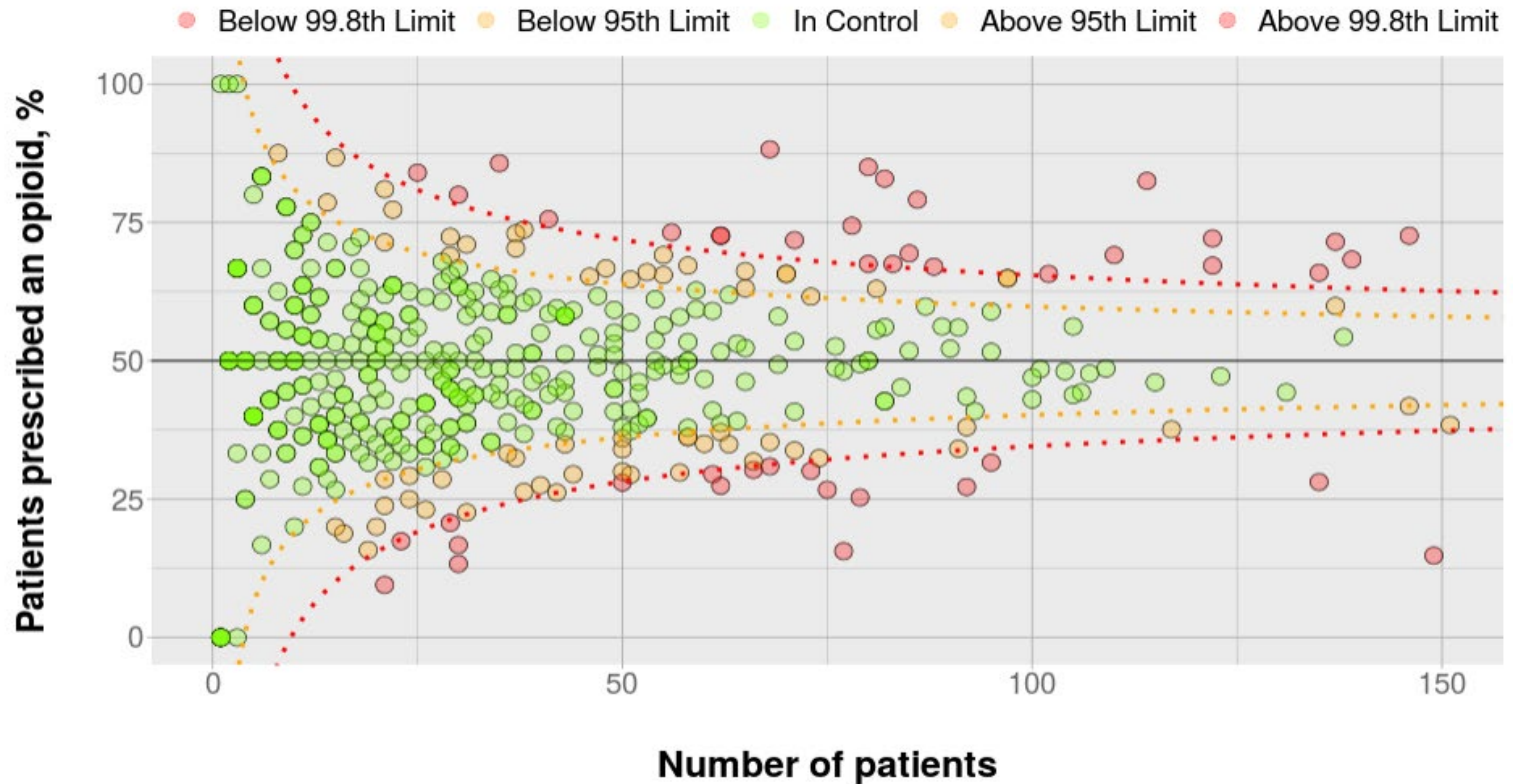


Case 1: Funnel Plots

- Which Ontario Hospitals have the **lowest** percentage of post-discharge 30-day mortality?
- Which geographical regions have the **highest** rate of lab-confirmed influenza?
- Which physicians **over** prescribe opioid medications?

Case 1: Funnel Plots

- Which physicians **over** prescribe opioid medications?
- **Note: Data are simulated**

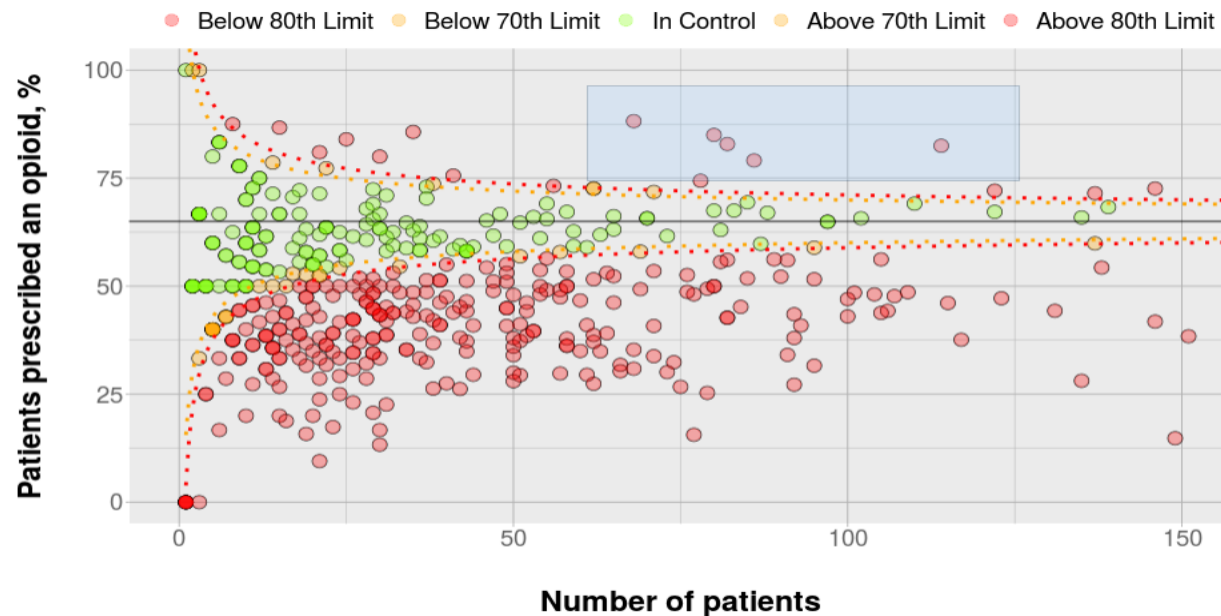


Case 1: Funnel Plots

- Dynamically Modify Parameters
 - *How does this data fare against other benchmarks? Provincial? National?*
 - *What about different thresholds?*
 - *Are some physicians extreme under one set of parameters versus another?*
- Analytics
 - *Who exactly are these extreme data points?*
 - *Are there any additional insights to be gained?*
- Report Generation
 - *Can we generate a comprehensive summary of our results?*

Case 1: FP Analysis

KPI Demo



Benchmark, %

Control Limit 1, %

Control Limit 2, %

Enter values of the parameters above. Click "Update" to view the new graph.

PDF Report

Download a PDF report.

Download Source Code used to generate your figure.

Show 10 entries

Search:

	PhysID 🏷️	n 🏷️	d 🏷️	r 🏷️	Sex 🏷️		Age 🏷️	Active 🏷️	Location 🏷️	Training 🏷️
142	142	60	68	0.882	F		57	22	Urban	Canadian
339	339	94	114	0.825	F		59	23	Rural	Canadian
368	368	68	82	0.829	M		53	20	Urban	Canadian
428	428	68	86	0.791	M		41	22	Major-Urban	International
484	484	68	80	0.85	F		59	25	Urban	Canadian

Showing 1 to 5 of 5 entries

Previous 1 Next

Case 1: Report

This report was generated on 8/6/2019 at 11:31am by
User: DEMO1

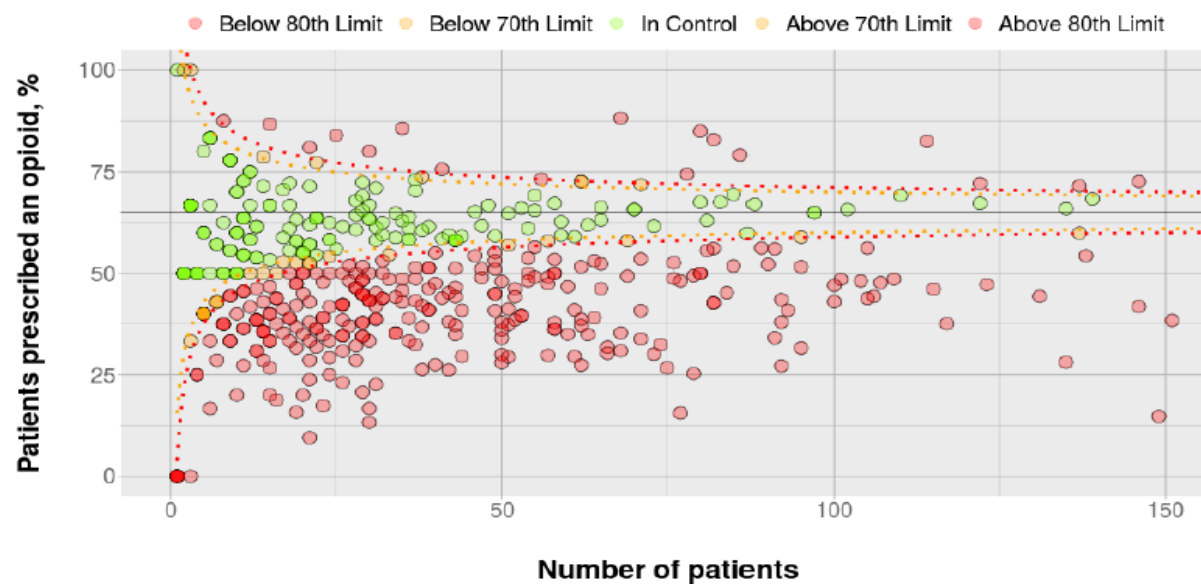
Figure 1: Funnel Plot – Opioid Prescribing

Benchmark: 65

Limit1: 70

Limit2: 80

Method: Normal Approximation



Case 1: Report



This report was generated on 8/6/2019 at 11:31am by
User: DEMO1

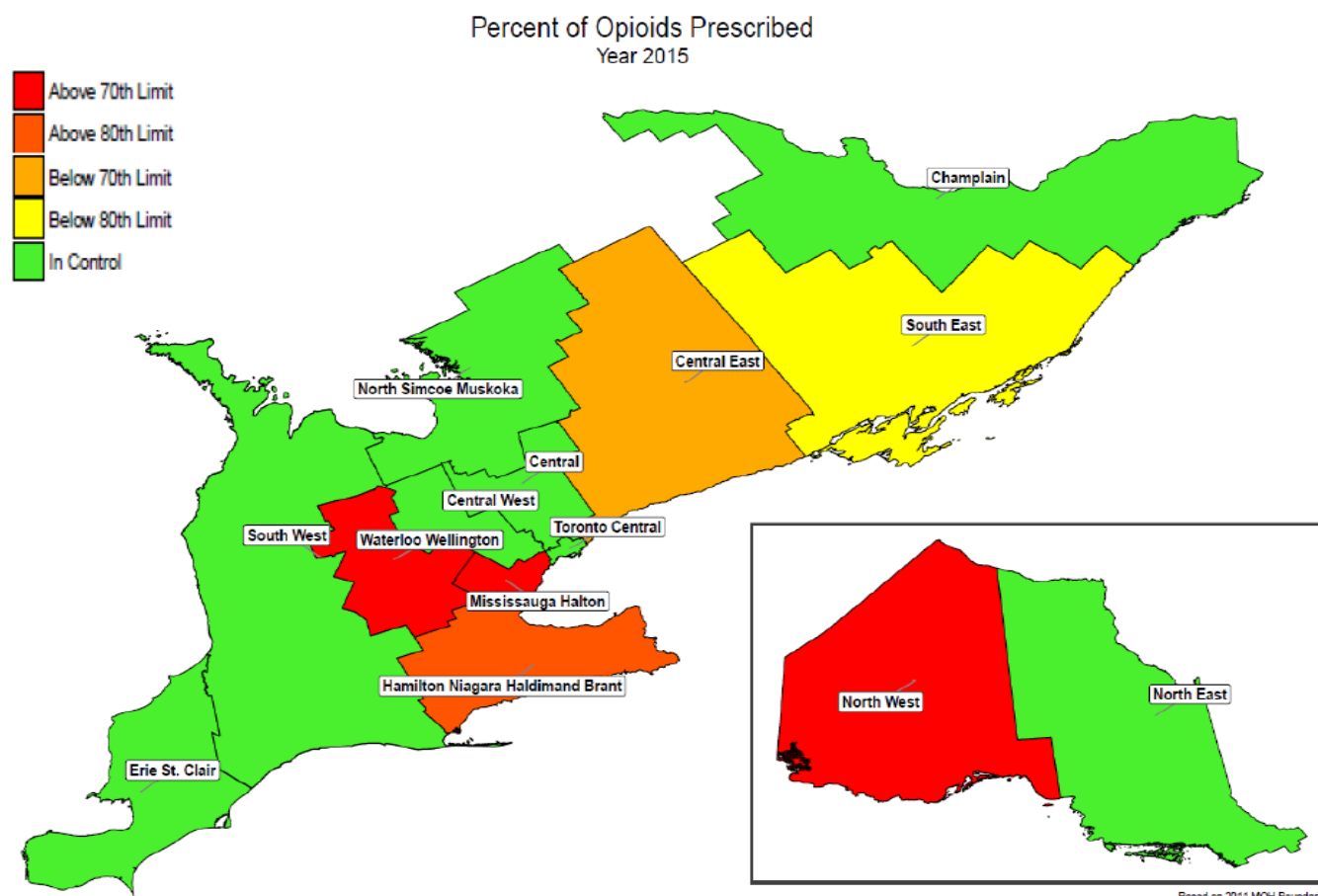
Table 1: Descriptive – Opioid Prescribing

	Level	Overall
Sample Size		500
Age (mean (SD))		40.15 (4.14)
Sex (%)	F	260 (52.0)
	M	240 (48.0)
Health Area (%)	Central	43 (8.6)
	Central East	40 (8.0)
	Central West	27 (5.4)
	Champlain	34 (6.8)
	Erie St. Clair	34 (6.8)
	Hamilton Niagara Haldimand Brant	31 (6.2)
	Mississauga Halton	31 (6.2)
	North East	38 (7.6)
	North Simcoe Muskoka	25 (5.0)
	North West	32 (6.4)
	South East	38 (7.6)
	South West	40 (8.0)
	Toronto Central	55 (11.0)
	Waterloo Wellington	32 (6.4)
Years Active (mean (SD))		13.06 (5.40)
Training (%)	Canadian	174 (34.8)
	International	147 (29.4)
	Unknown	179 (35.8)

Case 1: Report

This report was generated on 8/6/2019 at 11:31am by
User: DEMO1

Figure 2: Geographical Distribution – Opioid Prescribing



Case 1: Resources

Web App: *matt-kumar.shinyapps.io/funnel*

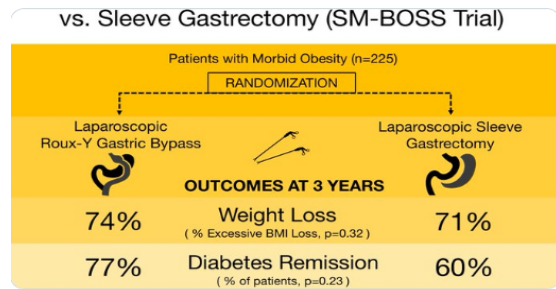
- Use your own data
- Extensive aesthetic control
- Generate high-res images

R Package (CRAN): *funnelR*

Case 2: Visual Abstracts

- Increasingly popular mode of disseminating scientific research results
- Effective for distilling key findings / top line results (and publicizing your study)

Annals of Surgery @AnnalsofSurgery · Oct 26, 2016
RCT: Laparoscopic Roux-Y Bypass versus Sleeve Gastrectomy, Outcomes at 3-years [#VisualAbstract](#) [journals.lww.com/annalsofsurger...](#)

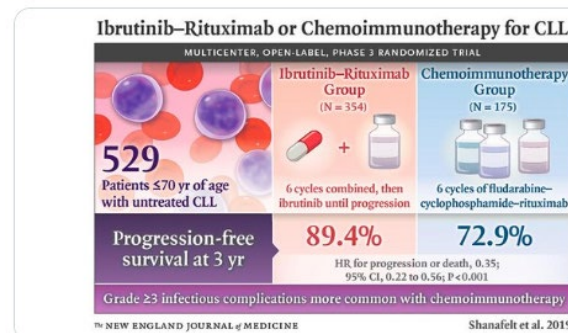


Annals of Surgery and 5 others

149 122

NEJM @NEJM · Aug 6

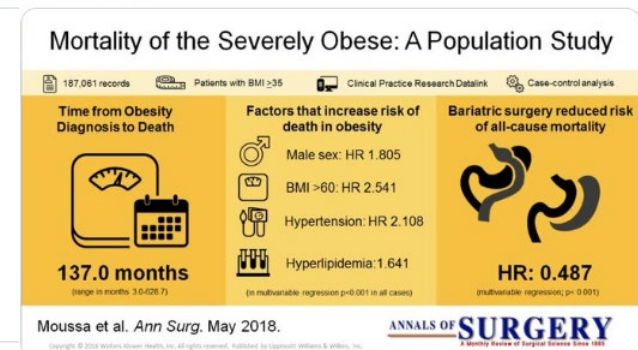
Visual Abstract: Ibrutinib-Rituximab or Chemoimmunotherapy in CLL
[nej.md/2K9cfsx](#)



1 21 43

Annals of Surgery @AnnalsofSurgery · May 25

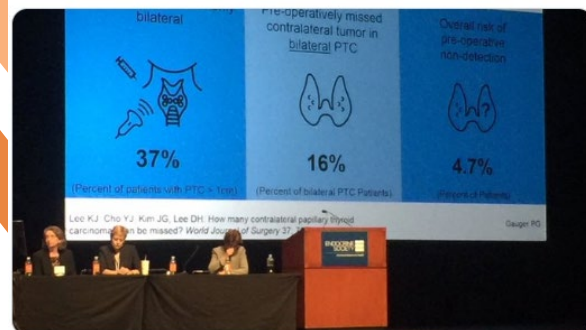
Mortality of the Severely Obese: A Population Study [bit.ly/2jnXCn2](#)
[#VisualAbstract](#)



40 67

Drew Shirley, MD @drewshirleymd · Apr 3, 2017

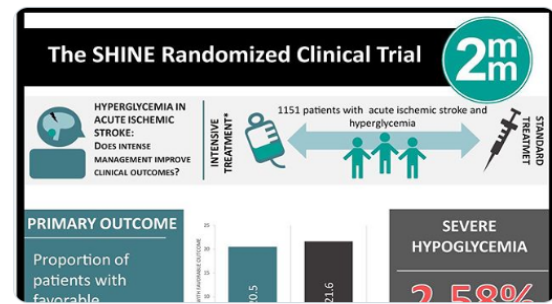
.@AndrewMibrahim's Visual Abstract (TM) makes an appearance at #AAES2017 #ENDO2017 pro-con debate thanks to his program director @pggauger



1 6 16

2 Minute Medicine® @2minmed · Jul 31

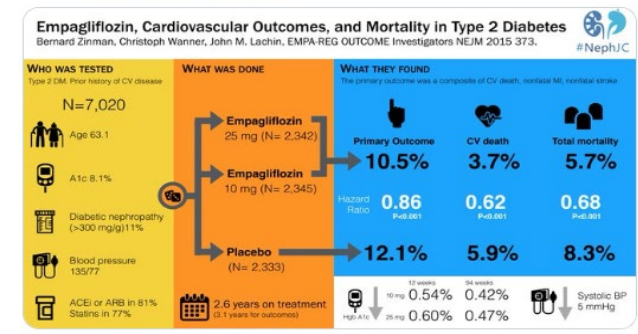
In this randomized controlled trial, intensive hyperglycemia treatment did not lead to improved outcomes compared to standard treatment in patients 90 days after stroke. . . Summary: [bit.ly/2SgLy dlvrit/R9QKDR](#) [#visualabstract](#) [#medicalnews](#)



1

Joel Topf, MD FACP @kidney_boy · Oct 15, 2017

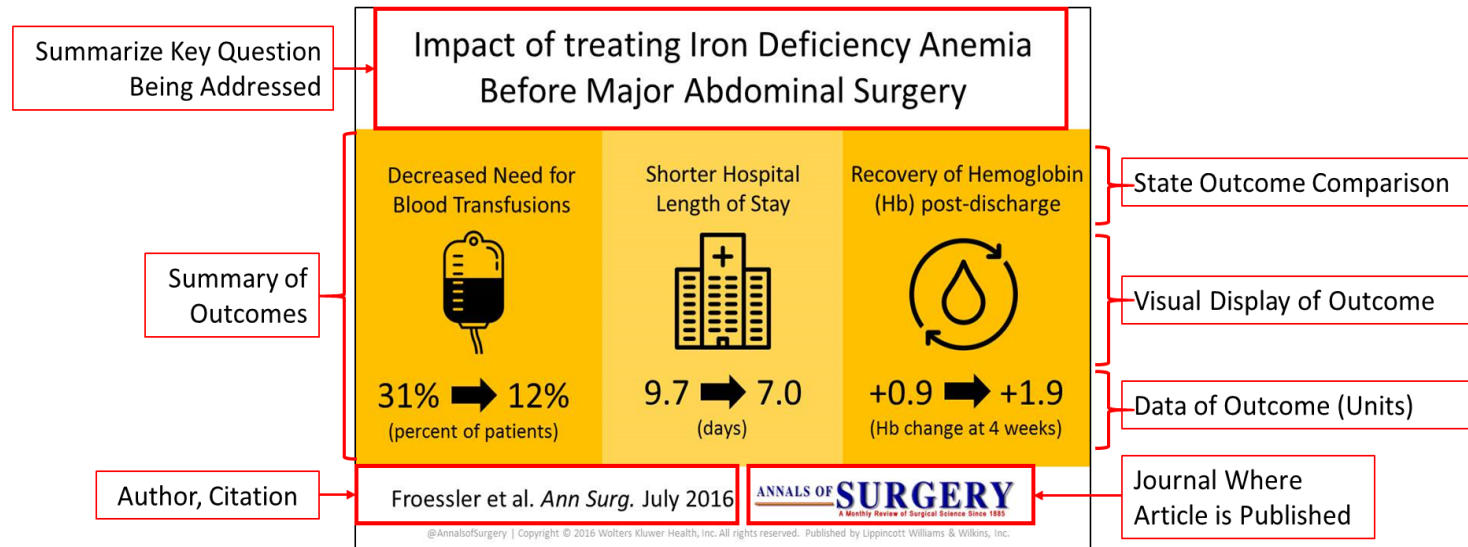
[#VisualAbstract](#) for EMPA-REG. First take, happy to hear feedback and make changes. [nejm.org/doi/full/10.10...](#)



8 16 45

Case 2: Visual Abstracts

COMPONENTS OF AN EFFECTIVE VISUAL ABSTRACT

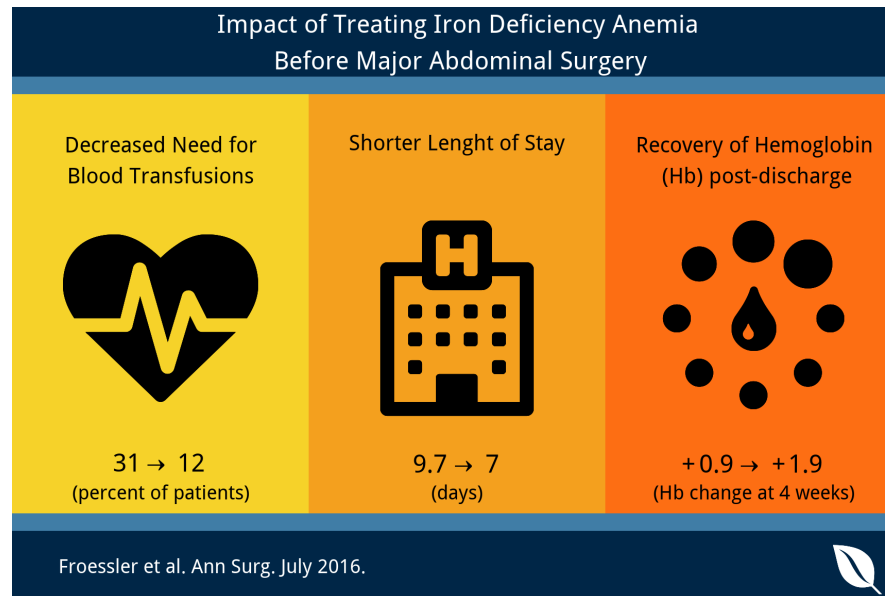


Reference Paper:

A Primer on How to Create A Visual Abstract (2016) – Andrew M. Ibrahim, MD, MSc, University of Michigan

Case 2: Visual Abstracts

"How difficult would it be to generate one of these?"



"My colleague is also interested in this for another study – can you help? "

Case 2: Visual Abstracts

Visual AbstractR

Use this app to build **Visual Abstracts**. Click the button below to see how it works.

[Start Tour](#)

No. of Panels

5

Panel 1 Panel 2 Panel 3 Panel 4 Panel 5 Borders

Panel

Panel colour

#FF0000

Text

Primary Title

Outcome 1

Font Size

8

Font colour

#000000

Secondary Title

...continued...

Font Size

8

Statistic

Statistic 1

Font Size

6

Unit

Unit 1

Font Size

6

Font colour

#000000

Icons

Icon

users

Icon Size

40

Icon colour

#2F3C47

Main Title of the Study
...continued...

Outcome 1 ...continued...	Outcome 2 ...continued...	Outcome 3 ...continued...	Outcome 4 ...continued...	Outcome 5 ...continued...
				
Statistic 1 Unit 1	Statistic 2 Unit 2	Statistic 3 Unit 3	Statistic 4 Unit 4	Statistic 5 Unit 5

Study Citation (year) Journal Name 

[Save Progress](#) [Download .png](#) [Download .pdf](#)

Case 2: Resources

Web App: *matt-kumar.shinyapps.io/visabs*

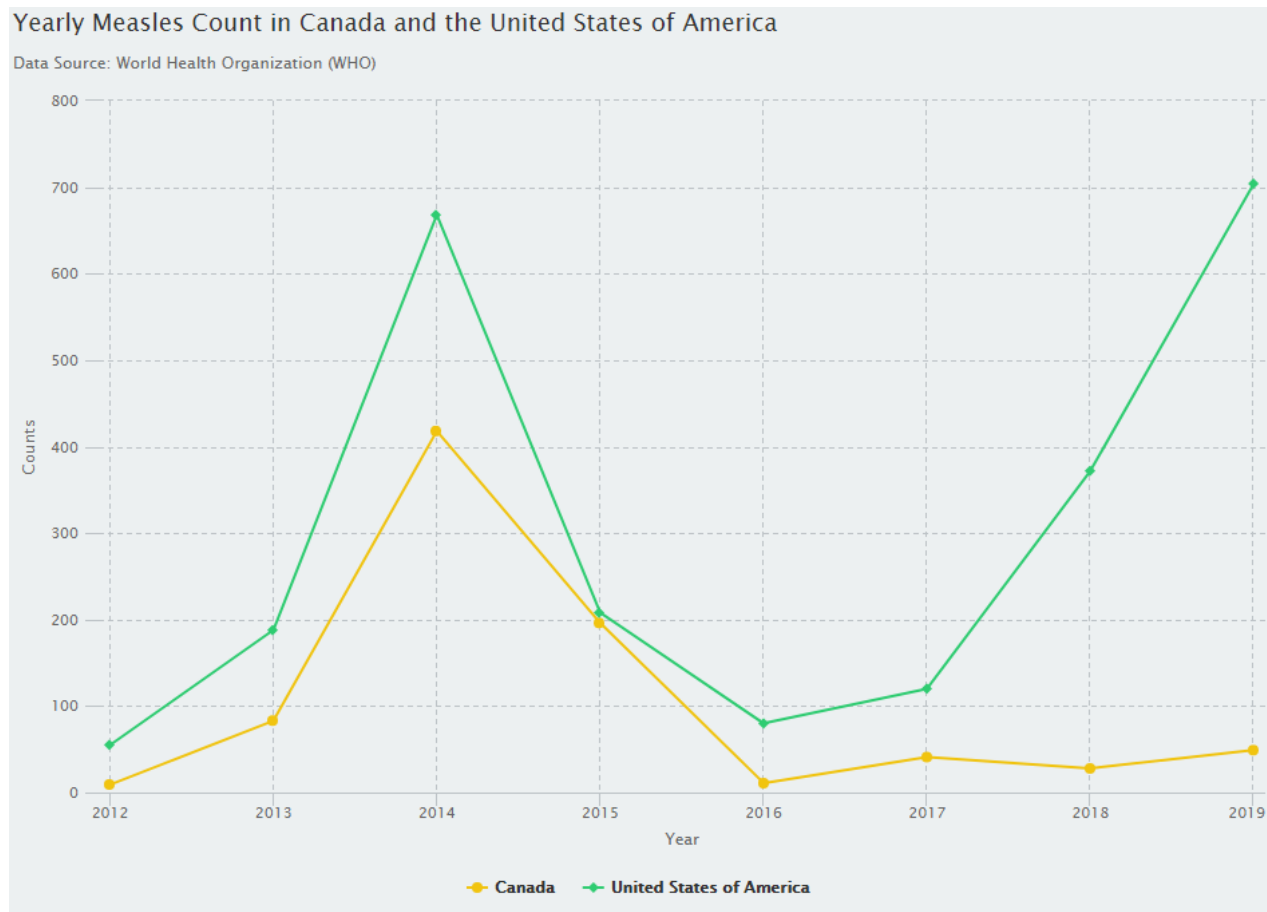
- Fixed layout, single icons
- Aesthetic control
- Generate high-res images

R Package (CRAN): *abstractR*

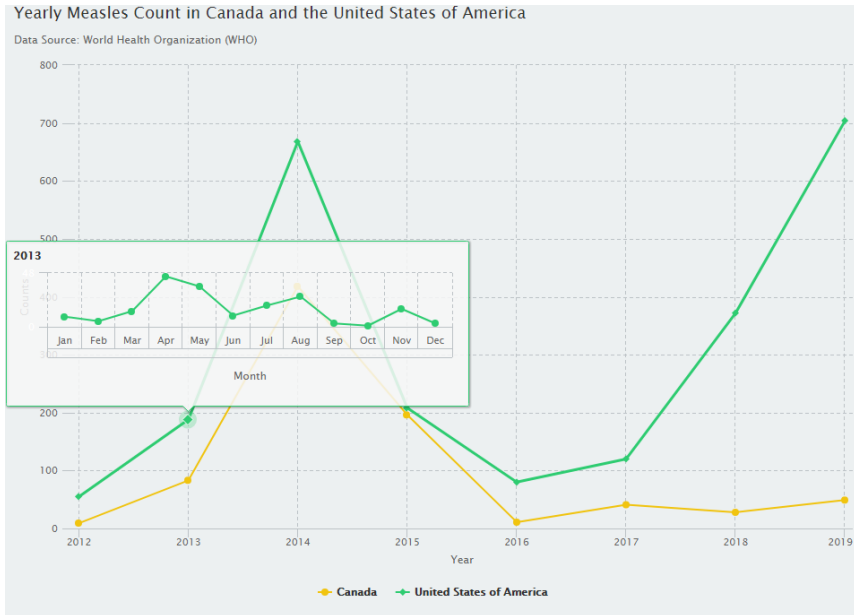
- Custom layouts (horizontal, vertical or mixed)
- Greatest aesthetic control
- Mixing multiple icons per panel

Case 3: Exploring Variation

- WHO Measles incidence data - publically available in excel workbooks
- Compare yearly trends of two countries

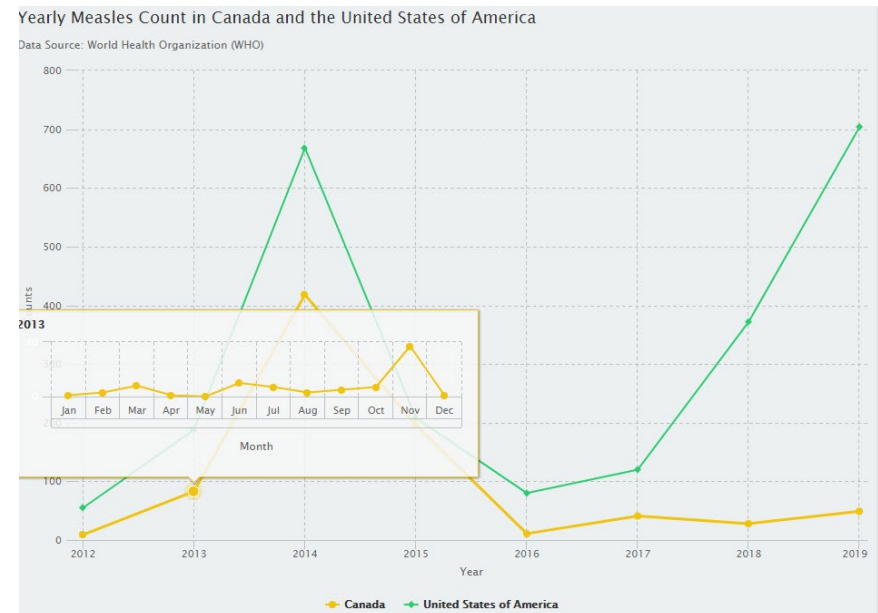


Case 3: Exploring Variation



- Simultaneously view **monthly** and **yearly** variation

Use of tool tips + drill down interactivity.



Case 3: Exploring Variation

Filter - view this for **any** two countries of interest

Choose 1st country:

Canada

Choose 2nd country:

Czech Republic

Cote d'Ivoire

Croatia

Cuba

Cyprus

Czech Republic

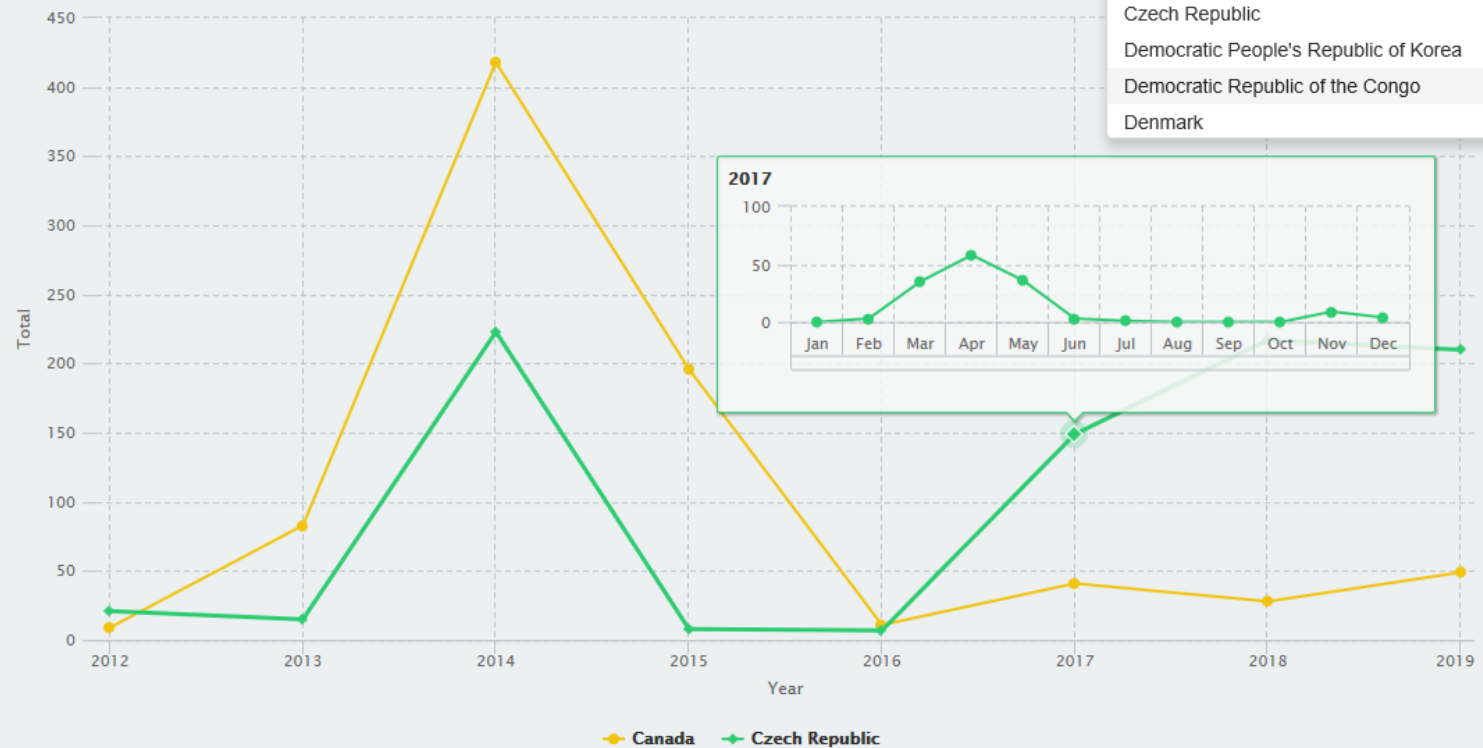
Democratic People's Republic of Korea

Democratic Republic of the Congo

Denmark

Yearly Measles Count in Canada and Czech Republic

Data Source: World Health Organization (WHO)



Case 4: Study Design

- A prototype tool to help expedite the creation of Observational / RWE studies using Registry Data
- Used by Analysts of the Registry entity to craft a data request in consultation with stakeholders.
- Useful in exploring specifications – generally unfamiliar with data elements, caveats or concepts of the registry holdings.
- The entity maintains a set of ***standardized*** SAS macros to access, extract and create data requests from the registries.
 - Can we leverage this to expedite the request?

Case 4: Study Builder

The screenshot displays the BuildR application interface. On the left is a sidebar with a teal header containing the BuildR logo and a hamburger menu icon. The sidebar lists the following sections: 'Begin' (with an 'Intro' button), 'Design' (with a 'Cohort' button), 'Data Sources' (with buttons for 'Survey', 'Drug Data', and 'Utilization Data'), and 'Finish' (with a 'Finalize' button). The main content area has a teal header with the title 'Introduction' and the text 'We're almost ready to start building your data request.' Below this, it says 'Please enter your information below to begin.' and features a 'More' button. A 'User Profile' modal is open in the center, containing a profile picture and four input fields: 'Name' (John Smith), 'E-Mail' (johnsmith@domain.net), 'Affiliation' (UHN Corp.), and 'Reference ID' (999).

BuildR

Begin

Intro

Design

Cohort

Data Sources

Survey

Drug Data

Utilization Data

Finish

Finalize

Introduction

We're almost ready to start building your data request.

Please enter your information below to begin.

More

User Profile:



Name

John Smith

E-Mail

johnsmith@domain.net

Affiliation

UHN Corp.

Reference ID

999

Case 4: Study Builder



Cohort Design

Let's start by defining your base cohort.

[More](#)

Cohort Design

Cancer Site Cohort:

Prostate

Accrual Start

2012-01-01

Accrual End

2013-12-31

Case Inclusion

Include Sexes:

Male Only

Include Ages:

0 18 65 105

☒ Include Missing Age

☐ Include Out of Province Patients

Demographic Variables

Show 10 entries Search:

	Description	Status
1	Rurality Index	Permissible
2	Neighbourhood Income	Permissible
3	Local Health Integration Network	Conditional
4	Immigration Status	Conditional
5	Postal Code	Restricted

Showing 1 to 5 of 5 entries Previous 1 Next

Case 4: Study Builder

Physician Claims

Use this area to request physician billing claims data for your cohort.

More

Cohort

Claims Source

Primary Care

Provider Type

Medical

Location

Office

Time Frame

Start (Years relative to diagnosis)

3

End (Years relative to diagnosis)

0

Claim Code List

Show 5 entries Search:

	Code	Description	BarPlot
1	A111	Diabetes Management (Old)	
2	A112	Diabetes Management (New)	
3	B123	Minor Consultation	
4	C243	Major Consultation	
5	E324	Vaccination Type 1	

Showing 1 to 5 of 10 entries

Previous 1 2 Next

Case 4: Study Builder

The screenshot displays the BuildR Study Builder interface. On the left is a navigation sidebar with a teal header containing the BuildR logo and a menu icon. The sidebar lists stages: Begin, Intro, Design, Cohort, Data Sources, Survey, Drug Data, Utilization Data, and Finish. A teal 'Finalize' button is at the bottom of the sidebar. The main area is titled 'SAS Script Preview' and contains an 'Editor' window with SAS code. The code includes comments for programmer, date, and request ID, followed by workflow initialization, cohort selection criteria, demographic retrieval, and physician claim linking. A 'Download SAS Script' button is at the bottom of the editor.

BuildR

Begin

Intro

Design

Cohort

Data Sources

Survey

Drug Data

Utilization Data

Finish

Finalize

SAS Script Preview

Editor

```
Request Reference ID: 999
*
*Programmer: Matthew Kumar
*Date Created: 2019-08-01 02:42:24
/*****/

*Init workflow;
%studystartup(refid=999, lastname=Smith, firstname=John);

*Get Base Cohort
%getcohort(site      = prostate,
            start     = '01JAN2012'd,
            end       = '31DEC2013'd,
            check_elig = Y,
            elig_date  = diagnosis,
            include_sex = male,
            include_age = %str(18 le age le 65),
            age_missing = Y,
            oop        = N,
            out        = tmp);

*Get Demographics;
%get_baseline_demo(in      = tmp,
                   refdate  = diagnosis,
                   demo_var = rural income immigration,
                   out      = tmp2);

*Link Physician Claims;
%get_p_claims(in      = tmp2,
              start    = diagnosis - (3 * 365),
              end      = diagnosis + (0 * 365),
              source    = prim,
```

Download SAS Script

Case 5: Decision Making

Physician Dashboard

PROFILE

PATIENTS

INDICATORS

Framingham Risk Calculator

Patient Attributes

Age: (30 to 74 only)

30

Gender:

☒ M
☐ F

Systolic blood pressure: (90 to 200 only)

93

is SBP under treatment:

No

Smoking:

Non-Smoker

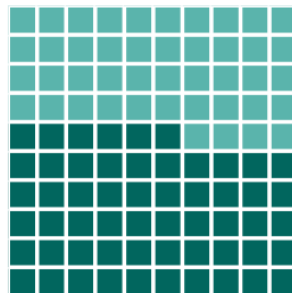
Smoker

yes

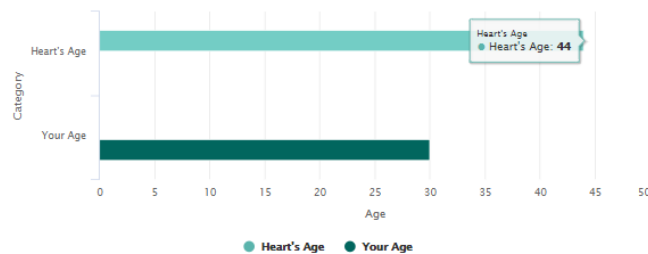
BMI: (15 to 50 only)

15

10 Year Risk



Heart Age



Interpretation

Your estimated 10 years risk of having a Cardiovascular disease is : 56 %. Due to your risk factors, your heart age is: 44 years.

Next Steps

Item 1
Item 2
Item 3

About

Disclaimer

Limitations

Reference Link

Questions?

Thank You!