

USING REPRODUCIBLE DATA VISUALIZATIONS TO AUGMENT DECISION-MAKING DURING SUPPRESSION OF SMALL COUNTS



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Health System Impact Fellowship: **Key Objectives**



Support Impact-Oriented Career Paths

Elevate the career readiness and expand the career options for doctoral fellows in HSPR through experiential learning and othe program enhancements (cohort + enriched competency training



Expand and Enrich the Traditional Training Environment

Engage health system and related organizations in preparing a cadre of promising PhD graduates for impactful careers.



Increase Organizations' Awareness of the Value of PhD-trained Individuals

Provide health system and related organizations with direct opportunities to realize and harness the benefits that PhD-trained individuals can bring to such organizations.

Health System Impact Fellowships





Dr. Meghan McMahon **IHSPR** Associate Director



35 HSI Fellows:

Dr. Robyn Tamblyn **IHSPR Scientific Director**



Example of A Virtuous Learning Cycle

Interpret Results: Are the results credible? What advice should be given?

Analyze Data: What practices associate with lower fall rates?

Reducing Falls in Nursing Homes

Assemble Data: How do we prevent falls? What is the fall rate? Based on your current practice, you might want to consider...

> Take Action: Change Current Practice: In whole or part...

Tailored Messages:

Decision to study falls 11

Health System Impact Fellowships



35 HSI Fellows:

The Learning Health System

Health systems--at any level of scale--become learning systems when they can, continuously and routinely, study and improve themselves

Source: Friedman et al., 2015



How can I contribute to Learning Health Systems?

- A. Popularize reproducible workflows
- **B.** Bridge data sources and information displays
- **C.** Build learning communities





http://www.bccdc.ca/health-professionals/data-reports/chronic-disease-dashboard

Changes Over Time Geography (Map) Sex Breakdown Data Table

Select a Disease

Mood & Anxiety Disorders, ...

Select a Rate Type

Select a Health Region

0 <>

17.67

Crude Incidence

All BC

Hierarchy of administrative units in **BC**: Health Service Delivery Areas (HSDA) nested within Health Authorities (HA).

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label_prov 🔅	label_ha 🌼	label_hsda 🔅
BC	Interior	East Kootenay
BC	Interior	Kootenay Boundary
BC	Interior	Okanagan
BC	Interior	Thompson Cariboo Shuswap
BC	Fraser	Fraser East
BC	Fraser	Fraser North
BC	Fraser	Fraser South
BC	Vancouver Coastal	Richmond
BC	Vancouver Coastal	Vancouver
BC	Vancouver Coastal	North Shore/Coast Garibaldi
BC	Vancouver Island	South Vancouver Island
BC	Vancouver Island	Central Vancouver Island
BC	Vancouver Island	North Vancouver Island
BC	Northern	Northwest
BC	Northern	Northern Interior
BC	Northern	Northeast

specific year. Choose a different disease, health region, or year from the menus on the right. Hover over an area to see the number of cases, precise value, and 95% confidence intervals.

The map below shows an overview of the selected disease and its geographic distribution in a

Crude Incidence per 1,000 population at risk for Mood & Anxiety Disorders, Episodic -Age 1+ in All BC HSDA(s), 2016/17 Sex = Both Sexes Total







disease	year	sex	incase	region_id	region_la	bel desc_label
Flower Deafness	1995	F	104	0	BC	BC
Flower Deafness	1995	F	25	1	HA	Interior
Flower Deafness	1995	F	15	2	HA	Fraser
Flower Deafness	1995	F	20	3	HA	Vancouver Coastal
Flower Deafness	1995	F	19	4	HA	Vancouver Island
Flower Deafness	1995	F	25	5	HA	Northern
Flower Deafness	1995	F	9	11	HSDA	East Kootenay
Flower Deafness	1995	F	7	12	HSDA	Kootenay Boundary
Flower Deafness	1995	F	4	13	HSDA	Okanagan
Flower Deafness	1995	F	5	14	HSDA	Thompson Cariboo Shuswap
Flower Deafness	1995	F	1	21	HSDA	Fraser East
Flower Deafness	1995	F	8	22	HSDA	Fraser North
Flower Deafness	1995	F	4	23	HSDA	Fraser South
Flower Deafness	1995	F	5	31	HSDA	Richmond
Flower Deafness	1995	F	7	32	HSDA	Vancouver
Flower Deafness	1995	F	8	33	HSDA	North Shore/Coast Garibaldi
Flower Deafness	1995	F	8	41	HSDA	South Vancouver Island
Flower Deafness	1995	F	5	42	HSDA	Central Vancouver Island
Flower Deafness	1995	F	6	43	HSDA	North Vancouver Island
Flower Deafness	1995	F	7	51	HSDA	Northwest
Flower Deafness	1995	F	9	52	HSDA	Northern Interior
Flower Deafness	1995	F	9	53	HSDA	Northeast
Flower Deafness	1995	М	97	0	BC	BC
Flower Deafness	1995	М	22	1	HA	Interior
Flower Deafness	1995	М	42	2	HA	Fraser
Flower Deafness	1995	Μ	21	3	HA	Vancouver Coastal
Flower Deafness	1995	М	19	4	HA	Vancouver Island
Flower Deafness	1995	М	20	5	HA	Northern
Flower Deafness	1995	М	7	11	HSDA	East Kootenay
Flower Deafness	1995	М	7	12	HSDA	Kootenay Boundary

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Must answer the questions:

1.

2.

- Can re-calculate from gender triplet?
- З.
- Can re-calculate from higher-order total?

Is the cell value smaller than a threshold?

Challenges with Manual method

- 1. Arduous
- 2. Time consuming
- 3. Prone to human error





FLOWER DEAFNESS - 1995

HA	HSDA		HSDA			HA			PROV		
Interior	East Kootenay	9	7	16	25	22	47	102	97	199	
Interior	Kootenay Boundary	7	7	14	25	22	47	102	97	199	
Interior	Okanagan	4	5	9	25	22	47	102	97	199	
Interior	Thompson Cariboo Shuswap	5	3	8	25	22	47	102	97	199	
Fraser	Fraser East	1	3	4	13	15	28	102	97	199	
Fraser	Fraser North	8	4	12	13	15	28	102	97	199	
Fraser	Fraser South	4	8	12	13	15	28	102	97	199	
Vancouver Coastal	Richmond	5	3	8	20	21	41	102	97	199	
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Vancouver Coastal	North Shore/Coast Garibaldi	8	9	17	20	21	41	102	97	199	
Vancouver Island	South Vancouver Island	8	7	15	19	19	38	102	97	199	
Vancouver Island	Central Vancouver Island	5	5	10	19	19	38	102	97	199	
Vancouver Island	North Vancouver Island	6	7	13	19	19	38	102	97	199	
Northern	Northwest	7	8	15	25	20	45	102	97	199	
Northern	Northern Interior	9	9	18	25	20	45	102	97	199	
Northern	Northeast	9	3	12	25	20	45	102	97	199	
		F	М	Т	F	М	Т	F	М	Т	

Approach in a nutshell

- 1. Split into frames
- 2. Apply redaction logic
- 3. Print a graph of each frame

Requirements for Automation

- 1. Reproducible
- 2. Verifiable
- 3. Extendable
- 4. Approachable

https://github.com/IHACRU/suppress-for-release



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Preserved by targeting

FLOWER DEAFNESS - 1995

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Interior	East Kootenay	9	7	16	25	22	47	102	97	199	
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Northern	Northeast	9	3	12	25	20	45	102	97	199	
		F	М	т	F	М	т	F	М	т	

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Is the cell value smaller than a threshold?
 Can re-calculate from gender triplet?
 Can re-calculate from higher-order total?

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Preserved by targeting

-OGICAL

FLOWER DEAFNESS - 1995

HA	HSDA		HSDA			HA			PROV		
Interior	East Kootenay	9	7	16	25	22	47	102	97	199	
Interior	Kootenay Boundary	7	7	14	25	22	47	102	97	199	
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https://github.com/IHACRU/suppress-for-release

FLOWER DEAFNESS - 1995 - draconian



Preserved by targeting

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FLOWER DEAFNESS - 1995 - targeted



Is the cell value smaller than a threshold?

Can re-calculate from gender triplet?

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Preserved by targeting

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Northern	Northeast	9	3	12	25	20	45	102	97	199	
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Fraser	Fraser South	- 4	8	12	15	15	30	104	97	201	
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Northern	Northern Interior	9	9	18	25	20	45	104	97	201	
Northern	Northeast	9	3	12	25	20	45	104	97	201	
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Documents > GitHub > bccdc > suppress-for-release > sandbox > examiner-2 > prints > Flower Deafness



Flower Deafness-1992.png

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Flower Deafness-1998.png



Flower Deafness-2004.png

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Flower Deafness-2010.png

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Flower Deafness-1993.png



Flower Deafness-1999.png



Flower Deafness-2005.png



Flower Dea	fness-2011.pn
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Flower Deafness-1994.png

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Flower Deafness-2000.png



Flower Deafness-2006.png





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Flower Deafness-1995.png

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-	Party and Online Research	17	is:	22	- 67	. 16	17	100	134	275
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Flower Deafness-2001.png

	FLOWER DEAFNESS - 2007									
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inere .	(remiser)			11	-21		.21	10	29	144
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And an arrival	Datement	. 8.	2.		23	- 11	34	18	-21	101
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fatternage in some	-Snuth European disease	1.0	1		14	12	18	14	-71	162
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Personal Address	really relationshipsed			10	14	10		- 10	11	100
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Surfaces.	Software industry	1	1	10		10	38		. 71	162
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Flower Deafness-2007.png



Flower Deafness-2013.png

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tringfor classical details?	1.4	14	14		- 94	16		
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Flower Deafness-2002.png

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Flower Deafness-2008.png



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Search Flower Deafness

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Flower Deafness-1997.png

	FLOWER DEAMACON 2003									
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1000	Answiget	2	1	1	14	21	-84	104	120	360
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- Contractor	Kolman Infenter	T	83	15	24	27	10	104	125	350
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Flower Deafness-2003.png

	FLOWER DEAP NEIST 2008									
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mase	Press Pauli	10		121		.81	14	1.8	1.24	742
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instead	NUTRIA	10	1	30	34	31	14	114	134	382

Flower Deafness-2009.png

Flower Deafness-2014.png



FRAMED (D_N) disease (D_2) ... $\mathbf{Y}_{\mathbf{K}}$ Y_1 year •••

[Long]						[Wi	de]										
disease	year	sex	incase	region_id region_labe	el desc_label	disease	year label_pro	v label_ha	label_hsda	HSDA_F	HSDA_M	HSDA_T	HA_F	HA_M	HA_T	BC_F	BC_M
Flower Deafness	1995	F	104	0 BC	BC	Flower Deafness	1995 BC	Interior	East Kootenay	9	7	16	25	22	47	104	97
Flower Deafness	1995	F	25	1 HA	Interior	Flower Deafness	1995 BC	Interior	Kootenay Boundary	7	7	14	25	22	47	104	97
Flower Deafness	1995	F	15	2 HA	Fraser	Flower Deafness	1995 BC	Interior	Okanagan Thuran Caribas Ch	4	5	9	25	22	47	104	97
Flower Deafness	1995	F	20	3 HA	Vancouver Coastal	Flower Deathess	1995 BC	Interior	Freedor Cariboo Shuswap	5	3	8	25	22	47	104	97
Flower Deafness	1995	F	19	4 HA	Vancouver Island	Flower Deafness	1995 BC	Fraser	Fraser North	8	4	12	15	15	30	104	97
Flower Deafness	1995	F	25	5 HA	Northern	Flower Deafness	1995 BC	Fraser	Fraser South	4	8	12	15	15	30	104	97
Flower Deafness	1995	F	9	11 HSDA	East Kootenay	Flower Deafness	1995 BC	Vancouver Coastal	Richmond	5	3	8	20	21	41	104	97
Flower Deafness	1995	F	7	12 HSDA	Kootenay Boundary	Flower Deafness	1995 BC	Vancouver Coastal	Vancouver	7	9	16	20	21	41	104	97
Flower Deafness	1995	F	4	13 HSDA	Okanagan	Flower Deafness	1995 BC	Vancouver Coastal	North Shore/Coast Garibaldi	8	9	17	20	21	41	104	97
Flower Deafness	1995	F	5	14 HSDA	Thompson Cariboo Shuswap	Flower Deafness	1995 BC	Vancouver Island	South Vancouver Island	8	7	15	19	19	38	104	97
Flower Deafness	1995	F	1	21 HSDA	Fraser East	Flower Deafness	1995 BC	Vancouver Island	Central Vancouver Island	5	5	10	19	19	38	104	97
Flower Deafness	1995	F	8	22 HSDA	Fraser North	Flower Deafness	1995 BC	Vancouver Island	North Vancouver Island	6	7	13	19	19	38	104	97
Flower Deafness	1995	F	4	23 HSDA	Fraser South	Flower Deafness	1995 BC	Northern	Northwest	7	8	15	25	20	45	104	97
Flower Deafness	1995	F	5	31 HSDA	Bichmond	Flower Deatness	1995 BC	Northern	Northern Interior	9	9	18	25	20	45	104	97
Flower Deafness	1995	F	7	32 HSDA	Vancouver	Flower Dearness	1995 BC	Northern	Northeast	9	3	12	25	20	45	104	97
Flower Deafness	1995	F	8	33 HSDA	North Shore/Coast Garibaldi												
Flower Deafness	1005		8		South Vancouver Island												
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By Andriy Koval, Ph.D. © 2018

https://github.com/IHACRU/suppress-for-release





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https://github.com/IHACRU/suppress-for-release



GitHub	> bccdc > suppress-for-release > sandbox
	Jame
	examiner-1
	examiner-2
	humbnails
	README.md



```
↓ TEST 1: What cells are `too small` ( < 5)</p>
16 # Censor 1: What cells should be suppressed as "too small"?
17 d1_small_cell <- df %>% detect_small_cell()
18 # creates a replica of the data, with count values are replaced by TRUE/FALSE according to test
19
20 # TEST 2: What cells can help calculate the suppressed cells from the same triple?
21 # because we need to remove them, otherwise they make recalculation possible.
22 # Censor 2: What triples should be suppressed? (eq. F-M-T)
   # reverse calculate from:
23
24 d2_recalc_from_triplet <- df %>% detect_recalc_triplet()
25
26 # TEST 3: Is this is the only triplet that is being suppressed in a higher order block?
27 # because if yes, recalculation is possible
28 # Censor 3: What cells should be suppressed as those that could be calculated from higher order count?
   d3_single_suppression <- df %>% detect_single_suppression()
29
30
31 - # ---- service-functions -----
32
   # function to elongate the VALUE (count) in the smallest decision frame
33
    d_long_values <- df %>% elongate_values()
34
35
   # function to elongate the LABEL (name) in the smallest decision frame
36
    d_long_labels <- df %>% elongate_labels(c("label_prov", "label_ha","label_hsda"))
37
38
   # create color scale to highlight suppression decisions
39
40
    d_colors <- bc_health_map %>% make_color_scale()
41
   # apply sequential logical tests to suppress desired cells
42
    d_combined_tests <- df %>% combine_logical_tests()
43
44
45 - # ---- graphing-functions -----
                                                                                           GitHub > bccdc > suppress-for-release > sandbox > examiner-2
46
   # prepare the context for suppression = smallest decision frame
47
                                                                                                                                \sim
   # create a list object containing required data in required shape to generate graphs
48
                                                                                                 Name
   1 <- df %>% prepare_for_tiling(bc_health_map)
49
50
51 # generate a graph of a single logical test
                                                                                                    prints
    df %>% make_tile_graph(bc_health_map)
52
                                                                                              examiner-2-targeted
53
54 # it is very useful to segregate how
55 # (1) a plot is assembled with graphing script from how
                                                                                                       (vignette)
56 # (2) a plot is committed to a hard digital form (PNG, JPG, PDF)
57 # can help us avoid going insane from trying to make it look right/useful on paper/screen
58 # there are many decision about the appearance of the plot that needs to be scripted
59 df %>% print_tile_graph(bc_health_map, path_folder = "./sandbox/examiner-2/prints/", size = 3)
60
61 # so far, df referred to a single Data Frame = a context for a single suppression decision
                                                                                                                                                16
62 # we can use a wrapper function to loop through a large number of frames
```

63





Conclusions

- Use case for reproducible workflows
- Transparent and Extendable
- Workflow maps + Dependency trees
- Approachable = Learning community
- Open-source = democratic + global collaboration

https://github.com/IHACRU/suppress-for-release



USING REPRODUCIBLE DATA VISUALIZATIONS

TO AUGMENT DECISION-MAKING DURING

SUPPRESSION OF SMALL COUNTS



Andriy Koval Assistant Professor



UNIVERSITY OF CENTRAL FLORIDA



Kate Smolina Director





Anthony Leamon Regional Epidemiologist



Thank you!

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